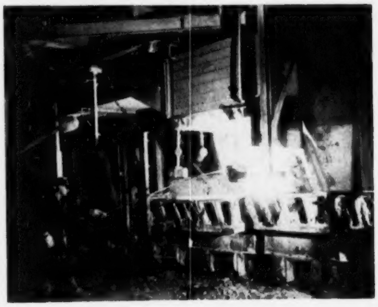
Chemical

INDUSTRIES

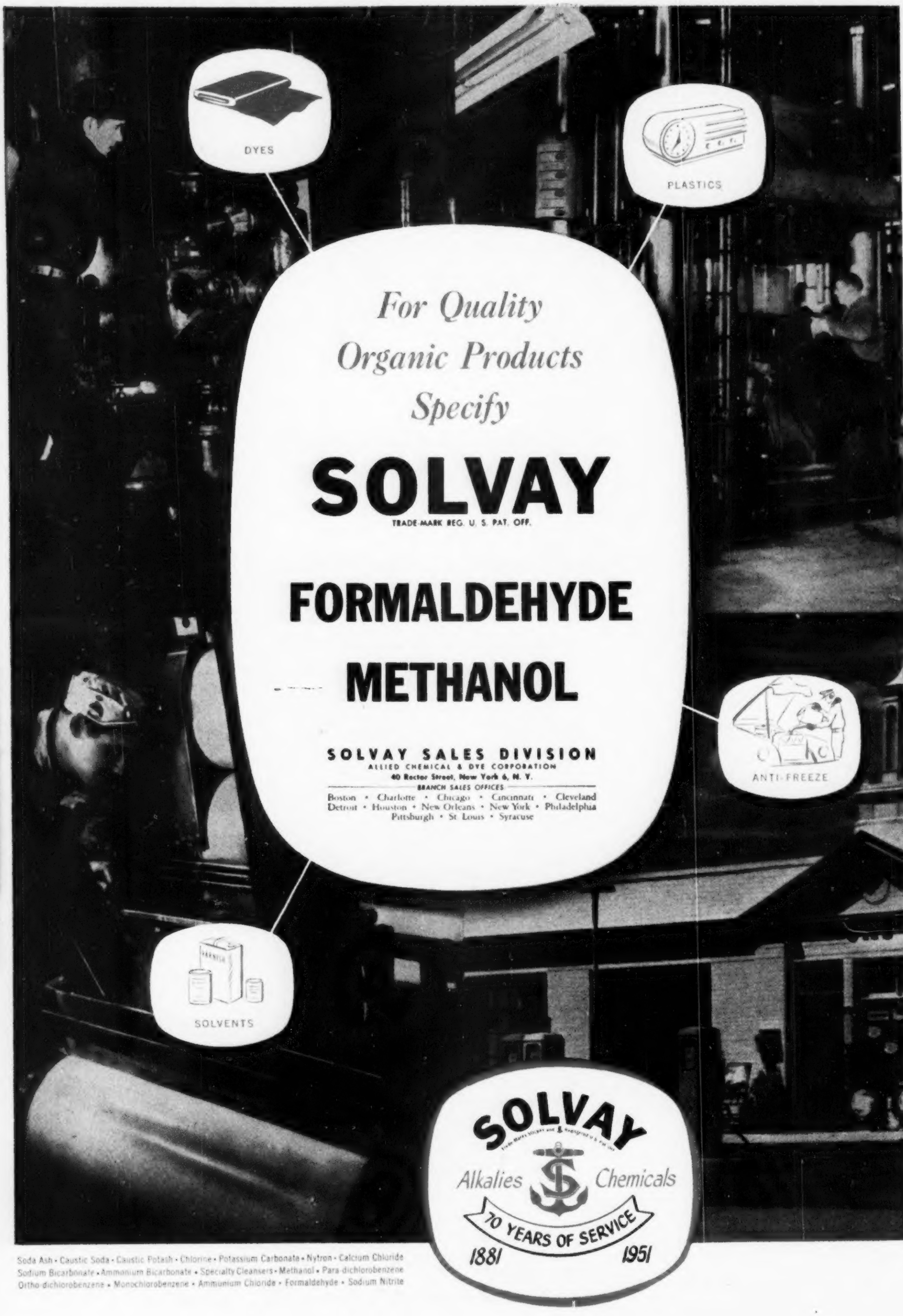
Week

April 28, 1951

Price 35 cents



A McGRAW-HILL PUBLICATION



DYES
PLASTICS
For Quality Organic Products Specify
SOLVAY
TRADE-MARK REG. U. S. PAT. OFF.
FORMALDEHYDE
METHANOL
SOLVAY SALES DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
BRANCH SALES OFFICES
Boston • Charlotte • Chicago • Cincinnati • Cleveland
Detroit • Houston • New Orleans • New York • Philadelphia
Pittsburgh • St Louis • Syracuse
ANTI-FREEZE
SOLVENTS
SOLVAY
Alkalies
Chemicals
70 YEARS OF SERVICE
1881
1951

Chemical INDUSTRIES Week

April 28, 1951

Volume 68 Number 15

Chemical Industries Week (including Chemical Specialties) is published weekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Publication Office: 1309 Noble St., Philadelphia 23, Pa.**

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 18, N.Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions to Chemical Industries Week are solicited in the chemical and process industries only from management men responsible for corporate affairs, purchasing, sales, marketing, packaging, research or chemical functions. Position and company connection must be indicated on subscription order. Address all subscription communications to J. E. Blackburn, Jr., Director of Circulation. Allow ten days for change of address.

Single copies 35¢. Subscription rates — United States and Possessions $5.00 a year; $8.00 for two years; $10.00 for three years. Canada $6.00 a year; $10.00 for two years; $12.00 for three years. Pan American countries $7.00 a year; $11.00 for two years; $14.00 for three years. All other countries $20.00 a year; $30.00 for two years; $40.00 for three years. Entered as second class matter April 5, 1951, at the Post Office at Philadelphia 23, Pa., under the Act of March 3, 1879. Printed in U.S.A.

OPINION . . . . .

New Herbicide Promise

To The Editor: I have just read your news report on the use of 2,4,5-T for the treatment of brush (Beating Brush with 2,4,5-T, Apr. 7). . . .

In the past, combatting brush has been comparable to some of the things that happen in dreams; one never was able to attain the sought-for goal. Something seemed to be restraining the land manager.

Notwithstanding the new experimental work on clearing range lands and rights-of-way, we think the brush killers will also find a place as a silvicultural tool in forestry practice. In many areas dense hazel brush cover has been suspected of being the chief deterrent to softwood reproduction. . . .

Perhaps new brush killers will be the answer to growing desirable species on these lands. . . .

E. A. Behr
Manager, Technical Dept.
Chapman Chemical Co.
Memphis, Tenn.

Route to Expansion

To The Editor: Your report on debt financing of chemical operations (Spotlight on Bonds, Apr. 7) is just about "on the button". . . .

From many points of view it would be better if chemical companies were able to meet their expansion needs through reinvestment of earnings or through equity financing, but taxes take such a large share of earnings that equity financing alone becomes very expensive.

It is, of course, dangerous to carry debt financing too far. A sound balance between the two seems the right answer. . . .

F. Eberstadt
F. Eberstadt & Co., Inc.
New York, N.Y.

Intriguing Potentialities

To The Editor: I find your article entitled, "Green Light For Hydrazine" (March 17), extremely interesting. There is no question in my own mind but that applications and uses of hydrazine and hydrazine derivatives are being developed at a rapid rate. The availability of cheap hydrazine will do much to encourage additional exploratory and evaluation research designed to make further use of the interesting chemical properties of hydrazine and its compounds. . .

I still feel that general use of hydrazine as a basic chemical commodity, rather than as a specialty chemical, will demand the development of a process which is economically and fundamentally different from any improvement or modification of the Raschig procedure. . . . It may be necessary to "shoot the moon" in the evaluation of any and all synthetic approaches to the production of hydrazine involving ammonia as the basic raw material.

Our recently published book, "The Chemistry of Hydrazine" (John Wiley and Sons) does make an effort to present the essential basic chemistry of this particular hydro-nitrogen and its simpler inorganic and organic derivatives. . . .

We hope that its appearance will stimulate added research designed not only to make hydrazine more readily available by new synthetic approaches, but will also attract attention of industrial laboratories to the potentialities of this very interesting substance.

L. F. Audrieth
University of Illinois
Urbana, Ill.

On Target

To The Editor: Remember a few weeks ago when one of your readers chided you—albeit gently—for leaning rather heavily on "popping." . . . In one issue you had silicone polishes popping up on store shelves . . . and plastic bottles of a new germicidal shampoo popping up in New Orleans.

In your response to his comments you said that roundly overworked popping was being led out to pasture. Is it back again? Last week you had "plenty of things popping in the synthetic detergent field. . ."

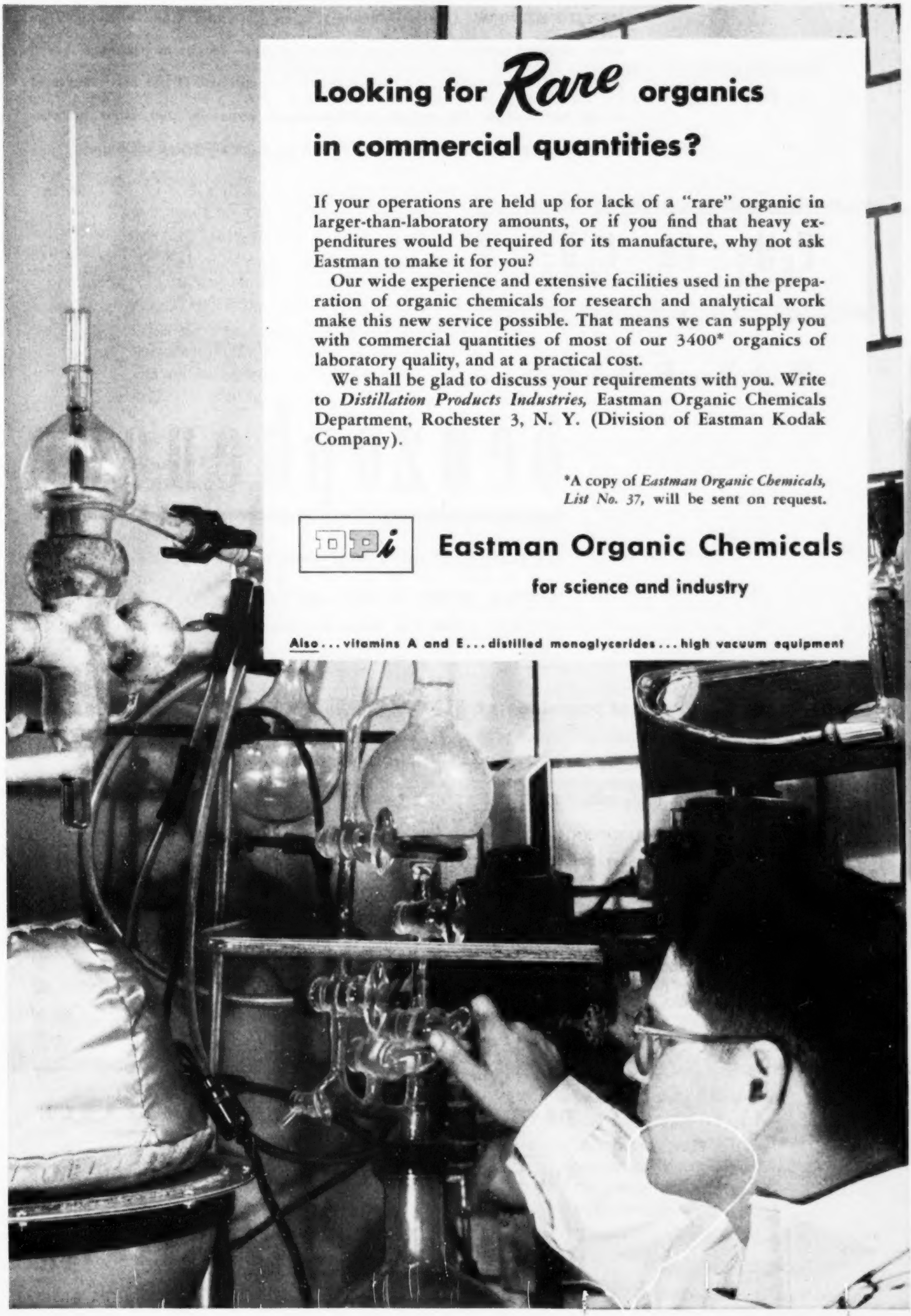
T. P. Folsom
Los Angeles, Cal.

P. S. Don't take my remarks too seriously; your articles have plenty of meat, are written zestfully, easy to read.

On target, eagle-eyed Reader Folsom. Spring is here. "Popping"—fresh and frisky—just cantered back to its old stomping ground. Ed.

CIW welcomes expressions of opinion from readers. The only requirements: that they be pertinent, as brief as possible.

Address all correspondence to: The Editor, Chemical Industries Week, 330 W. 42nd St., New York City.


Looking for Rare organics
in commercial quantities?
If your operations are held up for lack of a "rare" organic in larger-than-laboratory amounts, or if you find that heavy expenditures would be required for its manufacture, why not ask Eastman to make it for you?
Our wide experience and extensive facilities used in the preparation of organic chemicals for research and analytical work make this new service possible. That means we can supply you with commercial quantities of most of our 3400* organics of laboratory quality, and at a practical cost.
We shall be glad to discuss your requirements with you. Write to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).
*A copy of Eastman Organic Chemicals, List No. 37, will be sent on request.
DPi
Eastman Organic Chemicals
for science and industry
Also ... vitamins A and E ... distilled monoglycerides ... high vacuum equipment

Chemical INDUSTRIES Week
BUSINESS MAGAZINE OF THE CHEMICAL PROCESS INDUSTRIES

NEWSLETTER

Sulfur and sulfuric acid continue to hold the center of the stage this week as the National Production Authority listens, talks and acts to provide "fair shares for all" from inadequate supplies.

CIW said two weeks ago that action was being readied to allocate acid in the eleven Far Western states, where shortage is particularly serious. The action (Schedule 3 to the M-45 order) is now in effect.

Purchasers in the rest of the country must report end use to suppliers. This reporting system will enable NPA to get a clear picture of the national end-use pattern, will provide a factual basis for an eventual national control set-up.

Last week representatives of the major sulfur producers—Duval Texas, Freeport, Jefferson Lake and Texas Gulf—sat down with NPA officials to start hammering out a plan for sulfur allocation.

All producers agreed that it's up to Washington—and not to industry—to say which uses should be curtailed. Two of the industry men plumped for direct government allocation, a third favored informal direction, the fourth wanted to see detailed plans before commenting.

But Washington control is only one side of the sulfur story—the immediate, short-range side. Industry is busy with new processes, new sources; expects them to take noticeable effect next year (see p. 9).

NPA is trying now to round out a working outline of the overall chemical industry: production capacity, quantity and kind of raw materials and finished products. A couple of dozen chemicals are now being surveyed, several dozen more will be added to the list.

NPA says its survey is not for allocation purposes—it's only to provide an understanding of complex chemical interrelationships.

Government action specifying allethrin for military insecticides (CIW, Jan. 27, 1951) is still bearing fruit.

U. S. Industrial Chemicals is starting to build a $840,000 plant on its Baltimore property, expects to complete it by late '52.

Another large chemical firm has filed a certificate of necessity for an allethrin plant. U.S.I.'s "rapid-write-off" allowance is 50%.

Allethrin is a synthetic substitute for the natural insecticide, pyrethrum—and pyrethrum is in short supply.

The fluoridation-of-water battle rages at opposite ends of the continent: San Francisco will become the first California city to add fluorine to its drinking water when its program starts in August, following recommendation by the State Department of Public Health.

But New Jersey was urged this week to adopt a "wait-'til-the-dust-settles" policy. The state section of the American Water Works Association recommended further study. One reason: chemical and pharmaceutical concerns claim that fluoridation would create processing problems.

Shortage and consequent high price of tin is sparking interest in Alabama deposits explored during World War II. At the time, mining was not considered profitable, but with tin now at $2.50 a pound, private interests have raised $100,000 to start mining 200 tons a year.

Coosa Cassiterite Corp. is the firm's name, and it expects to start operations within a month.

Still tentative is a much larger operation by Alabama-Coosa Tin Co., which has applied to the Defense Minerals Administration for a $35 million loan. Planned—if the money is forthcoming—is a plant to produce 25 tons of tin per day from 5,000 tons of ore.

Two other deposits of vital minerals are currently getting Government attention: cobalt in Alabama, titanium in Florida.

U. S. Bureau of Mines is studying samples of ore described as "unusually high" in cobalt, is readying a report which will guide future action. Urgent needs for cobalt promise early action.

Meanwhile, Congressmen Sikes and McMullen of Florida, from the vantage points of the House Appropriations and Public Lands Committees, are pressing for development of titanium deposits in their state.

Corporate news of this week was Pittsburgh Plate Glass Co.'s purchase of American Cyanamid Co.'s 49% interest in Southern Alkali Corp.

Purchase price was about $19 million—which gives Cyanamid a healthy chunk of capital for contemplated expansion.

You can expect to hear more about primaquine—reportedly the most promising synthetic antimalarial available. Developed at Columbia and the University of Chicago under Government auspices, the drug will soon get large-scale tests in Nicaragua.

Reported four times as effective as its predecessors, primaquine has shown excellent preliminary results against the most stubborn forms of recurrent malaria. Also hinted at by early work is effectiveness against other types of diseases.

New products, new processes, new techniques: More and more pharmaceutical makers are hopping aboard the synthetic-bulk-laxative bandwagon. Two new laxatives—Whitehall Pharmacal's Melculose and Serutan's Sedagel—are based on carboxymethyl cellulose. And Dow Chemical's Methocel has been accepted into the National Formulary; Dow is now selling it as Methocel, N. F.

Air Reduction Co.'s dry ice has been based in the past on by-product carbon dioxide, but two new plants, one at Niagara Falls and another at Kansas City, make the gas as a primary product by burning natural gas and furnace gases. Airco is also experimenting with tank-truck delivery of liquid oxygen in the Buffalo area.

Watch for a new line of products soon from Pittsburgh Coke & Chemical Co.—fine chemicals based on the firm's aromatic raw materials.

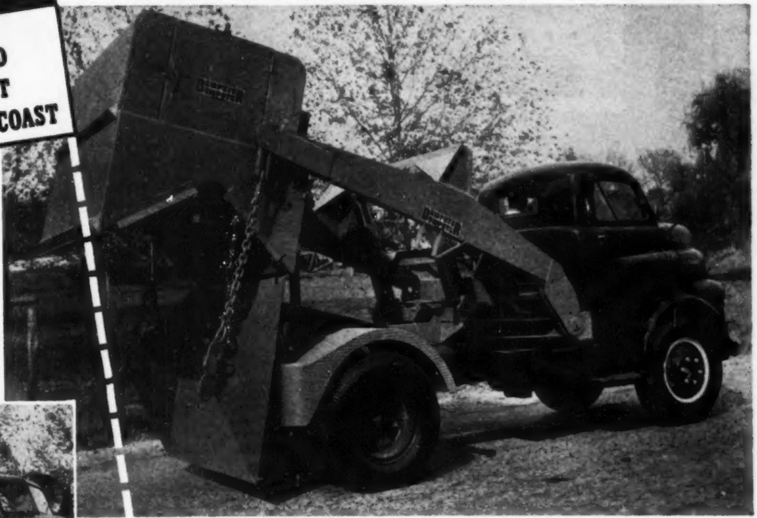
Ammonia makers got a sales boost this week from Mississippi's state agricultural experiment station, which reported to tung growers that liquid ammonia was cheaper—by $3 an acre or more—than ammonium nitrate, the cheapest solid nitrogenous fertilizer.

. . . The Editors

★ DEMPSTER DUMPSTER SYSTEM

SERVING COST-MINDED MANAGEMENT FROM COAST TO COAST

. . . handling bulk materials of every description at phenomenal savings



Photos show the three simple stages of servicing a container. The Dempster-Dumpster, operated from hydraulic controls in the cab by one man, the driver, picks up each container, places it in carrying position, and hauls it to point of disposition where it may be dumped or set down intact.

The General Electric Company, well known for sound management, is among the hundreds of cost-minded manufacturers using the Dempster-Dumpster System of bulk materials handling . . . the system recognized across the nation for its efficiency and ability to reduce costs!

Cuts Cost of Equipment and Operation — One truck-mounted Dempster-Dumpster performs the work of from 3 to 5 conventional trucks . . . reducing investment, maintenance and man hours tremendously.

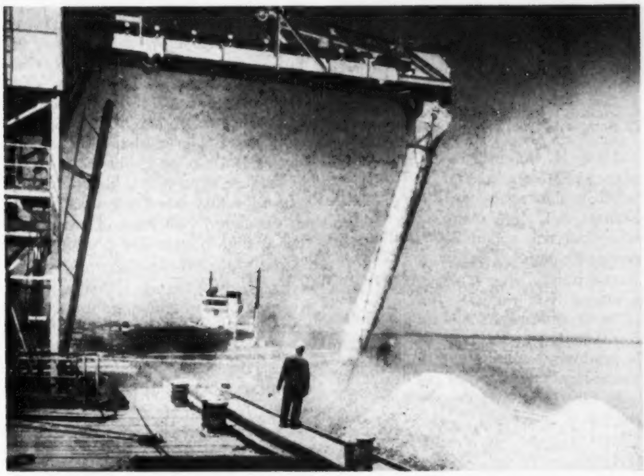
Eliminates Standing Idle Time—Truck never stands idle while being loaded nor do loading crews stand idle while truck makes haul. One Dempster-Dumpster services any number of detachable containers ranging in size up to 12 cu. yds. and in a wide variety of designs best suited to the type of materials handled—be they bulky, light or heavy . . . solids, liquids or dust . . . trash or rubbish.

Eliminates Re-Handling of Materials—Dempster-Dumpster Containers are placed at the very spot where materials accumulate—inside or outside buildings. Materials placed in these containers remain there until taken to destination and dumped or set down intact.

Increases Efficiency, Sanitation and Good "Housekeeping"—The Dempster-Dumpster System is a complete, unified plan for plant-wide cleanliness. Containers built to handle trash and refuse are fire-proof, rat-proof and fly-proof. Contents cannot be scattered by wind or scavengers. Regardless of your particular materials handling problem . . . raw products, finished products, trash or rubbish—it will pay you to investigate the Dempster-Dumpster System now! A product of Dempster Brothers, Inc.

DEMPSTER BROTHERS, 251 Dempster Building, Knoxville 17, Tennessee

BUSINESS & INDUSTRY . . . . .



LOADING SULFUR BARGE: New sources, new process techniques foreshadow . . .

What's Ahead for Sulfur

Pressed by cutbacks in sulfur supplies, industry is busy developing new sources to supplement now-inadequate brimstone tonnage.

New sources include: new sulfur domes, increased use of pyrite, production of acid from anhydrite, exploitation of surface deposits, and conservation of present production.

Prospect: No major relief from the present situation until late 1952 when these new supplies hit the market in volume.

Today industry's bloodhounds are searching for, and finding, sulfur to relieve the worldwide shortage.

This shortage is not absolute in the sense that no sulfur is available, for there is—but nearly all additions to present supplies will cost more than the Frasch-mined product from Texas-Louisiana domes that has fueled the world's sulfuric acid plants since the early '20s.

No one, or even two or three approaches will overcome the present sulfur shortage; rather, many of them will have to be exploited: the hydrogen sulfide content of natural gas and refinery gases, pyrites and pyrrhotite, new Frasch-minable domes, surface sulfur deposits, gypsum, and improved recovery of now-discarded waste acid.

Last but not least is the substitution of other acids for sulfuric. Example: Imperial Chemical Industries' process, now being pilot-planted, to replace sulfuric acid with nitric acid in solubilizing phosphate rock for fertilizer use. The nitrogen values are recovered as valuable ammonium nitrate.

Frasch-Minable Sources: Sulfur producers are keeping their fingers crossed as they and the Export-Import Bank pour money into the development of new Frasch-minable sulfur supplies. There may be recoverable sulfur and, again, maybe not.

In any event costs will be high. Most of the domes are in locations that have been avoided for many years because of unusual terrain conditions. An example is Freeport's development of the marsh-covered dome at Bay Ste. Elaine, La.: All buildings and the power plant for exploratory drilling are being built on barges 75 miles away from the final location; the barges will then be floated into position and sunk in place.

Freeport has also started development of the Nash dome, southeast of Houston, and arrangements have been made to prospect the Dog Lake, Lake Pelto, Venice and Garden Island Bay marsh domes in Louisiana.

Texas Gulf is developing a dome at Spindletop near Beaumont, Texas while Jefferson Lake is completing a sulfur-mining plant at the Starks dome in Calcasieu parish in Louisiana under arrangements with Texas Gulf and Carter Oil.

It has been known since 1902 that geological structures similar to those in Texas and Louisiana exist on the Isthmus of Tehuantepec in Southern Mexico.

Based on ten years' exploration and development, approval by the Export-Import Bank of a $1,875,000 loan to the Mexican Gulf Sulphur Co. (affiliated with Texas Gulf) and its Mexican subsidiary, Mexican Sulfur Co., will speed sulfur production from the company's concessions in Mexico, near the oil refinery center of Minatitlan. Proved reserves are estimated at 1.5 million tons of recoverable sulfur. Initial plans call for annual production of 200,000 tons.

In 1949 an exploratory oil well in North Central Alberta yielded a fifteen-foot bed of black sulfur at 3,040 feet. In the nearby Chisholm well a ten-foot bed of yellow sulfur occurred at 3,630 feet. Sunbeam Sulphur, Ltd. is now working out plans

AMMONIUM SULFATE PLANT: Both ions from natural gas.

for recovery from these sources. Sunbeam has the Alberta government's sulfur permit No. 1, for two-year exploitation rights on 96,000 acres. Difficulty: The location is far from civilization and practicability of the Frasch process at such depth is questionable.

Petroleum and Natural Gas: Sporadic efforts have been made to produce sulfur from the hydrogen sulfide content of certain natural gas deposits as well as of gases resulting from the refining of sour (high-sulfur) crudes.

Six units are now in operation and many more are on the way, particularly in West Texas. Phillips will recover about 100 tons per day in two plants; Stanolind and Sid Richardson are planning installations; Shamrock has 25-ton-a-day plant under construction at Dumas in the Texas Panhandle.

Lion is building a 10-ton-a-day plant at El Dorado, Ark., while Mathieson is increasing production at its Stamps, Ark. unit. Also, Consolidated Chemical will spend $500,000 to recover 30 tons of sulfur per day at Baton Rouge, La., from gases at the adjacent Esso refinery.

In a unique installation, Guanos Fertilizanted de Mexico, at Coahtitlan, is producing ammonium sulfate from natural gas. A sour gas furnishes not only the sulfur, but the remainder of the gas is converted to ammonia in a Chemico plant. In conjunction with General Chemical, Petroleos Mexicanos is recovering sulfur from the Poza Rica natural gas field in Mexico.

Pyrites and Pyrrhotite: Before cheap brimstone, sulfuric acid was largely produced by burning pyrite or pyrrhotite, both iron sulfides. The present shortage has reawakened the Rip-Van-Winkle pyrite-mining industry.

Noranda Mines at Hamilton, Ontario (*CIW, March 3, 1951*) is installing a $4 million plant to produce elemental sulfur and sulfuric acid from pyrites. Pyrite furnaces are being dusted off, returning from the oblivion of disuse to which they were consigned when Texas-Louisiana sulfur made them obsolete.

Pyrites make up the sulfur content of many high-sulfur coals. Their removal, along with other ash-forming constituents, has left huge "gob" piles of refuse. Peabody Coal Co. and several other Midwestern coal companies are interested in a process developed by Singh & Co. to handle this refuse. A $2.5 million plant, handling 100 tons of refuse per hour would yield an estimated 260 tons of sulfur per day at slightly over $10 per ton.

Bethlehem Steel is planning to mine pyritic iron ore in Pennsylvania. Eventually Bethlehem hopes to supply most of the pickling acid for its Sparrows Point, Md., steel mill. The iron oxide, remaining after formation of sulfur dioxide, will be fed into its blast furnaces.

General Chemical is mining pyrrhotite in Virginia, while Freeport Sulphur has taken an option on a 770-acre tract in the same general area. Exploration is under way to determine if the tract should be acquired. This, however, must be considered a long-range proposition.

Surface Sulfur: Chemical Construction has advanced a new process for recovery of elemental sulfur from non-Frasch-minable deposits (*CIW, Feb. 10, 1951*). A plant is under construction in Colombia, South America, and this process will probably be used to tap Wyoming surface sulfur deposits.

Anhydrite and Gypsum: A large group of British sulfuric acid users are building the world's fifth plant to make sulfuric acid from anhydrite. At a cost of £3.5 to £4 million, a plant will be installed to produce 150,000 tons of sulfuric acid and a slightly larger quantity of cement (*CIW, April 21, 1951*).

Enough: Out of this welter of activity, it is safe to predict that an adequate supply of sulfur and sulfuric acid will be available within two years. However, industry, already having tightened up on sulfuric acid consumption (production in 1950 was only slightly higher than in 1949) will have to endure the squeeze best as it can during the uncomfortable interim.

Know Your Washington ABC's

For businessmen this week, there is good news from Washington. To cut the existing confusion, GSA published a directory of all mobilization agencies. Here are some of the pertinent facts on key agencies for the chemical industry:

NPA—National Production Authority (Commerce Dept.). Manly Fleischmann, Administrator. Controls and directs defense production activities, except mining and agriculture. NPA's Chemical Division issues orders and directives allocating chemical products.

ODM—Office of Defense Mobilization—Charles E. Wilson, Director. This is the top Mobilization Agency which coordinates and controls all activities —economic, materials and manpower. Wilson reports to the President.

ESA—Economic Stabilization Agency. Eric Johnston, Administrator. Overall direction of price and wage stabilization. Johnston reports to ODM Wilson.

OPS—Office of Price Stabilization (under ESA). Michael V. DiSalle, Director. Administers price control over everything except food. Chemical industry's pricing problems will be handled chiefly by OPS's Rubber, Chemicals and Drugs Division.

WSB—Wage Stabilization Board. Cyrus Ching, chairman (includes 8 other members), recommends wage stabilization policies. WSB reports to Johnston's ESA.

DPA—Defense Production Administration. William H. Harrison, Administrator. This is a programming agency for the production phase of the mobiliza-tion program. It does the planning which NPA carries out.

DMA—Defense Minerals Administration (Interior Dept.). James Boyd, Administrator. Controls production and distribution of minerals, including chemical metals, from mine to smelter. NPA takes over from there.

"PROBLEMS ASSOCIATED WITH THE USE OF CHEMICALS *have been with us always, and at no time have they been free from differences of opinion between varied groups of interest. As knowledge of chemistry has increased so has the complexity of appraisal . . . We must not, however, strive for or require such perfection of knowledge that real progress is hampered. History of the use of chemicals would seem to support adequately the idea that development of all possible information is not required before obvious benefits can be judged to be safe."*

Food Chemicals Fight Axe

Delaney Committee reconvenes, hears U. S. Department of Agriculture officials defend food and chemical industries.

Witnesses testify to necessity of chemicals in growing, preparing and storing foods, assert that public is well protected by vigilance of governmental agencies and industry.

The chemical and food industries found able champions last week among Federal agency officials who testified before the Delaney Committee.

Hearings of the reconstituted Select Committee (*CIW, April 7, 1951*) began this month, and USDA officials were first on the docket to discuss the role of chemicals in foods and fertilizers.

A letter to Delaney from K. T. Hutchinson, Assistant Secretary of the USDA, was the first item introduced into the record. In it he says: "The advice and assistance of industry have been solicited and freely given. . . . These contributions . . . have aided materially in developing sound relation between the use of chemicals and agricultural economy." Tenor of his letter was the economic necessity of food processing chemicals: "Without them the growers' market for fruits, vegetables, and livestock products would be chaotic, and the consumer would be deprived of the continuous, orderly flow of provisions which permits wide selection of excellent food at all seasons.

New Legislation Urged: First witness to appear in person was John R. Matchett, Assistant Chief of the USDA's Bureau of Agricultural and Industrial Chemistry.

Reiterating the need for chemicals, he went on to cite how the food and chemical industries themselves act to protect public welfare. His example was the substitution of other flour bleaching agents for nitrogen trichloride when inconclusive evidence suggested the remote possibility of harmful effects. "It is interesting to note," he said, "that this action was taken at the instance of the milling industry itself acting in concert with the principal manufacturer of nitrogen trichloride."

Regarding the over-all situation, he asserted, "The food industry and food research institutions have long regarded the proper safeguarding of use of chemicals as an urgent responsibility."

But he did suggest that an amendment to the Food, Drug and Cosmetic Act—to establish Federal authority for examination of scientific evidence, conduct of its own tests, and attestation of safety of proposed food additives before they are put in use—might be in order.

Hormones and DDT: Later witnesses dealt with specific safety problems accompanying use of chemicals.

Theodore C. Byerly, in charge of the Animal Husbandry Division, defended the use of diethylstilbestrol, a synthetic sex hormone, to "caponize" poultry and thus produce more and better meat. About 30 million chickens were treated last year, he said, and the market paid about 5¢ a pound more for the treated birds. He said there is no evidence that the hormone accumulates in the body tissues, where it might be passed on to eaters. On the contrary, the USDA thinks that hormone use, as permitted by the Food and Drug Administration, "has benefitted many poultry growers and has supplied consumers with poultry meat of improved quality."

U. S. Public Health Service officials, Paul A. Neal and Wayland J. Hayes, deprecated earlier testimony to the effect that DDT may well be the cause of an increased number of deaths from cardiovascular diseases.

Neal and Hayes contended that no evidence of injury to humans from chronic exposure to DDT has ever been authenticated. Acute poisoning cases have been reported and verified, but recovery has been prompt and complete. Improper handling admittedly may cause injury, but the public need have no fear of DDT poisoning.

Fertilizers Necessary: Kenneth C. Beeson, director of the U. S. Plant, Soil and Nutrition Laboratory, Ithaca, N. Y., commented on the need for chemical fertilizers to overcome mineral deficiencies in the soil. He also blasted critics by citing exhaustive tests where there was "no evidence of any deleterious effect . . . from the use of chemical fertilizers."

Mild Laws Foreseen: The cool reasonableness of the testimony—which, to all appearances, favorably impressed the Committee members—clearly reduces the danger of hasty, ill-advised legislation to curb chemical use.

Hearings were resumed this week after a week's lapse, but witness Byerly, during his cross-examination, may well have sounded the keynote that will guide the Committee's final recommendations. He doubted that rigid criteria could be set up for chronic and acute toxicity tests on all chemicals. He felt, rather, that each individual material must be judged by applicable standards.

Hutchinson sounded the same theme when he wrote to Delaney: "Problems associated with the use of chemicals have been with us always, and at no time have they been free from differences of opinion between varied groups of interest. As knowledge of chemistry has increased so has the complexity of appraisal. . . . We must not, however, strive for or require such perfection of knowledge that real progress is hampered. History of the use of chemicals would seem to support adequately the idea that development of all possible information is not required before obvious benefits can be judged to be safe."

BORTON AND MACY: They point to record of how . . .

OIT Clamps Down On Exports

Present guide to export control is the Department of Commerce's "positive list," and today's outlook is for controls to continue indefinitely. Office of International Trade is responsible for enforcing the Export Control Act of 1949. Its prime function is to make certain that exports of critical materials go for essential use in friendly countries, are kept from prospective enemies.

Keeping tabs on end use and final destination of the United States' voluminous exports is the unenviable task facing Commerce Department's Office of International Trade. This week, for instance, the office qualifies its statement on the revision of the first-quarter, 200,000-ton allocation of sulfur for export. An additional 30,000 tons, explains OIT, will be used (by the affected countries) for essential purposes only.

Export Patrol: To check on the exports, OIT carefully examines and screens all requests from foreign countries. In the case of the recent action on sulfur, there is a double check. Since the British—principal beneficiaries of the revised quota—pay for sulfur from their scarce supply of dollars, they take particular pains to see that all the material goes to high-priority industries.

Aided by the Treasury Departments' Bureau of Customs (and the Justice Department, if prosecution is necessary), OIT is responsible for enforcing the Export Control Act of 1949. Aside from seeing that critical materials get into essential industries, the agency must make sure that no strategic items get into unfriendly hands.

To justify their activity during recent months, OIT Director Loring K. Macy and John C. Borton (Assistant Director for Export Supply) merely point to the record. During the fourth quarter of 1950, for example, 4,164 selected applications were referred to the Investigation Staff for screening; complete investigations were conducted in 649 cases. All told, 536 applications and licenses (involving shipments valued at over $8.5 million) were refused because of staff fiindings. In addition, nineteen warnings were issued on minor infractions and four orders were issued revoking or suspending exports of twelve individuals or corporations.

Export Control: Commerce Department itself is the center of a hot dispute over exports. The problem boils down to a single question: To what extent can the United States ship raw materials without seriously hindering its own war potential?

Taking one side are exporters and foreign countries. Exporters understandably want to stay in business; but on their side is also the undisputable logic that defense efforts and economic stability of friendly nations must not be undemined by totally refusing them a share of the available raw materials. Domestic consumers, on the other hand, seeing even 1% of total goods going overseas, besiege Congress to stop the shipments.

At present, the guide to export control is the Commerce Department's "positive list." An item on the list requires an approval export license before it can be shipped to any country except Canada.

Furthermore, quarterly quotas are established for each article on the list. The quotas fall into four classes —ranging from "zero quotas," prohibiting all exports, to "open-end quotas," allowing shipments in fairly substantial quantities. The positive list includes practically all chemicals, although many of them are on open-end quotas.

Before any article goes on the positive list, three factors must be taken into consideration: domestic supply, world supply, and the effect of exports on world supply.

Decision to place an item on the list is made by the Secretary of Commerce on the advice of an interdepartmental committee, which includes members of other governmental departments that have an interest in the subject.

Outlook: The Export Control Act expires in June, but it seems like a safe bet that Congress will extend it. Regardless of the turn of events in Korea, government control of exports will continue. Even if the fighting is reduced to an armed truce, export control will become a major weapon in the economic war against communism.

Montana Gets Gas

Passage of a bill last week in the Alberta legislature means that natural gas will be exported from Alberta to Montana. The gas will provide a source of power for Anaconda's important defense operations.

The gas will be transported by a pipeline that will run 21 miles to the international line and another 35 miles to the Cutbank, Montana field. At that point, it will join the Montana Power Co. pipelines to the Butte, Anaconda, and Great Falls installations. Under the terms of the bill, 10 billion cu. ft. of gas annually may be exported from the Pakowski Lake field (near Manyberries) in Southeastern Alberta. The gas will be exported by McColl-Frontenac Oil Co., Ltd., and the Union Oil Co. of Calif., which brought up the Pakowski field reserves.

Corncob Stymie

Temporary shut-down of the U. S. Department of Agriculture's synthetic liquid fuels pilot plant at its Northern Regional Research Laboratory, Peoria, Ill., points up a tug-of-war between USDA and the Department of the Interior for funds to carry out liquid fuels research. Interior, whose emphasis is on oil shale and coal, is ahead at the moment; but USDA is pressing for appropriations to continue its development of agricultural wastes.

Despite emergency conditions which would provide an excuse for continuation of experiments, further research on liquid fuels from farm wastes, such as corn cobs, has been temporarily abandoned.

There is some dissatisfaction, particularly at USDA, that Congress is not giving equal and simultaneous emphasis to this phase of fuels research as it is giving to the Department of Interior's research on shale and coal.

USDA has operated a semi-works plant at Peoria. When the plant closed at the end of June, it had been operating continuously, processing 550 pounds of corncobs an hour. During 1949 and 1950 funds for the operation of the plant were transferred to Agriculture from Interior.

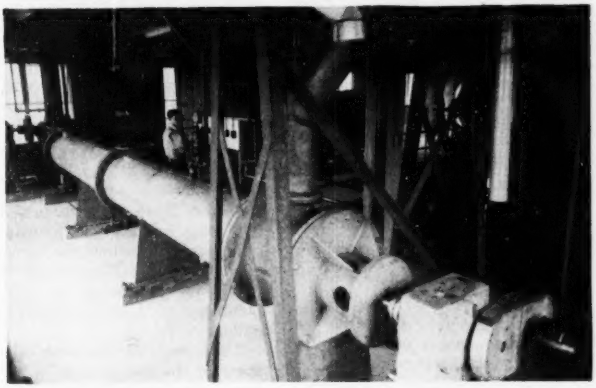
Pentosans Utilized: The plant was operated in close cooperation with the Northern Regional Research Laboratory, which is studying the conversion of the xylose in the pentosan hydrolysates to furfural, and the fermentation of the pentose and dextrose sugars to liquid fuels.

Basically, the hydrolysis under study consists of converting one fraction of agricultural residues—pentosans—into pentose sugars, and another fraction—cellulose—into dextrose.

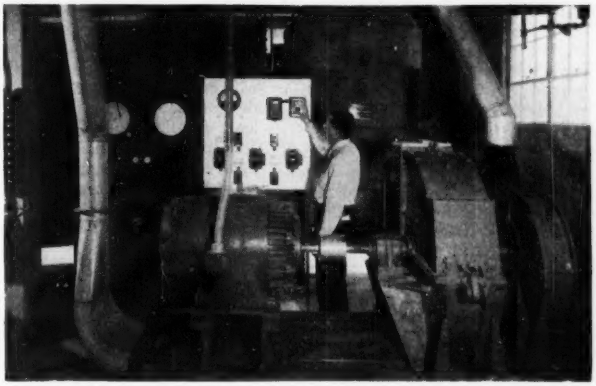
The pentose sugars may be fermented to butanol, isopropanol, acetone, and ethanol, or they may be converted to furfural. Dextrose can be converted to ethanol.

On the basis of data gathered during operation of the plant, major alterations in the process were recommended. USDA claims that the estimated cost of producing xylose after these changes would make it competitive with the sugars in blackstrap molasses.

Farms Use Much Petroleum: USDA is interested because 15 percent of total U.S. consumption of gasoline, kerosene, distillate and liquid gas is used on farms. In 1950 U.S. farms consumed 9.8 billion gallons of



CRUSHED CORNCOBS enter pentosan hydrolyzer cylinder through spout at right. Dilute sulfuric acid flows countercurrently from left.



MILLING EQUIPMENT grinds cob residue for hydrolysis of cellulose. The dilute acid solution, now containing pentoses, goes to neutralizer.

NEUTRALIZING TANK receives sugar solutions. Lime is added and dilute syrup is fermented. Various alcohols, acetone and furfural are products.

petroleum fuels—7.6 billion as motor fuel and 2.2 billion as household and other uses.

The semi-works plant closed down because neither Interior Department nor USDA were given money to carry on for the July 1950-June 1951 fiscal year.

USDA hopes to persuade Congress that further research is needed in the interest of national defense, further hopes to get money in the 1952 budget.

EXPANSION . . . .

Dow: Expansion program for this year will entail an outlay of $65 million, with an even larger expenditure slated for 1952. The program is principally designed to increase production of Saran and magnesium.

•

Celanese: New plant (*CIW March 31*) will be located in Pampa, Texas, 50 mi. east of Amarillo. Hydrocarbon feed stocks and natural gas fuel will come from the surrounding area, output will supplement the present plant at Bishop, Texas.

•

Minnesota Min. & Mfg.: $6.5 million expansion plans will cover manufacturing facilities, offices, and warehouses in 10 cities. New production facilities are scheduled for plants in Bristol, Pa., Wayne, Mich., and St. Paul, Minn. In Hastings, Mich., a pilot plant for studying and producing synthetic polymers for resins and tape adhesives will be constructed. Another pilot unit at Hastings will be built for the study and production of fluorocarbons.

•

Atomic Energy Commission: This week, Procter & Gamble is negotiating a contract to operate the reactivated Army Ordnance Pantex plant at Amarillo, Tex. The work will be done for the AEC. Construction work there is now under way, is scheduled for completion within a year. The new facilities will cost $22 million.

•

Sinclair Oil: To expand the use of research facilities and technical personnel, the company has formed a new subsidiary, Sinclair Research Laboratories, Inc. The new company will take over all research activities for the Sinclair companies, including the labs at Harvey, Ill.

•

MacMillan Bloedel, Ltd.: Two large timber firms, H. R. MacMillan Export Co., and Bloedel, Stewart & Welch, will merge operations to form British Columbia's largest lumber, pulp, and plywood concern. The move means erection of a single forest operating unit worth more than $100 million and employing over 8,000 persons.

Directors of the two firms have approved the amalgamation in principle, but the transaction is still subject to stockholder sanction.

•

Bureau of Mines: In order to meet the increasing military and industrial requirements for helium, the bureau will reopen its $3.5 million World War II plants for producing the gas. The plant has an annual capacity of 48 million cu. ft.

The bureau has also awarded a contract for the construction of a fourth zirconium plant at its electric development laboratory at Albany, Ore. Completion of the new building (costing $350,000) will bring the total investment by the government in the Albany lab to over $1 million.

•

Shell Oil of Canada: The company will establish a plant in Alberta for the production of sulfur from petroleum for the Powell River Co. and other British Columbia pulp and paper producers. The plant will be built at Jumping Pond, near Calgary, will cost $500,000. It will start production in the early part of 1952 at an annual rate of 10,000 tons.

•

Barrett Division: A new Applications Research Building will be built at the company's Edgewater (N. J.) site, and the present Research Laboratory Building will be enlarged.

FOREIGN . . . . .

Italy: The country is finding it difficult to meet demands for its sulfur. The problem arose as a result of the closing of many Sicilian mines in 1948-9 (because of inability to cope with the competition from American exporters). Production in 1950, however, at 230,000 tons, was 15% higher than in 1949. Of the total, 184,000 tons were exported—in 1949 only 33,000 were shipped out of the country. Domestic requirements (150,000 tons) were met by reducing stocks—probably to a dangerous level.

•

South Africa: Sweeping changes in export regulations now forbid exports, except under license, of a wide range of commodities. Included in the new order are manganese, sulfur, and industrial chemicals. In general, though, articles destined for the United Kingdom and the United States will not be affected. Except for a few items, exports to those countries will be exempt from the licensing order.

•

France: The French Government is studying the possibilities of making synthetic rubber to supplement expensive imports of the natural material. The French Union of Chemical Industries reported to the government that by 1954, France could produce 30 to 40 thousand tons of GR-S and 10 to 12 thousand tons of butyl. The proposed GR-S would fill about 25% of France's total estimated needs, the butyl production would cover the entire demand for inner tubes.

An investment of about $52 million would be necessary for the GR-S project if it were produced from petroleum, about $14.5 million if made from alcohol. France has a chronic alcohol surplus, but in spite of a robust government subsidy, production is an expensive proposition. Long-range cost factors make the production from petroleum a better bet. An additional $13 million would be needed for the proposed butyl rubber production.

KEY CHANGES. . .

Roy A. Hunt: From president, Alcoa, to chairman, executive committee.

Irving W. Wilson: From senior vice president, Alcoa, to president.

Leon E. Hickman: To vice president and general counsel, Alcoa.

Brig. Gen. Edw. Montgomery: To executive vice president, Chemical Construction Co.

Arthur T. Bennett: From Mathieson v. p. to manager of operations, H. K. Ferguson, at the Betania alkali plant in Colombia.

George W. Naylor: To chief of Kopper's office in Washington, D.C.

John V. McGrevy: From secretary, Merchants Chemical Co., to vice president, Chemical Manufacturing Co.

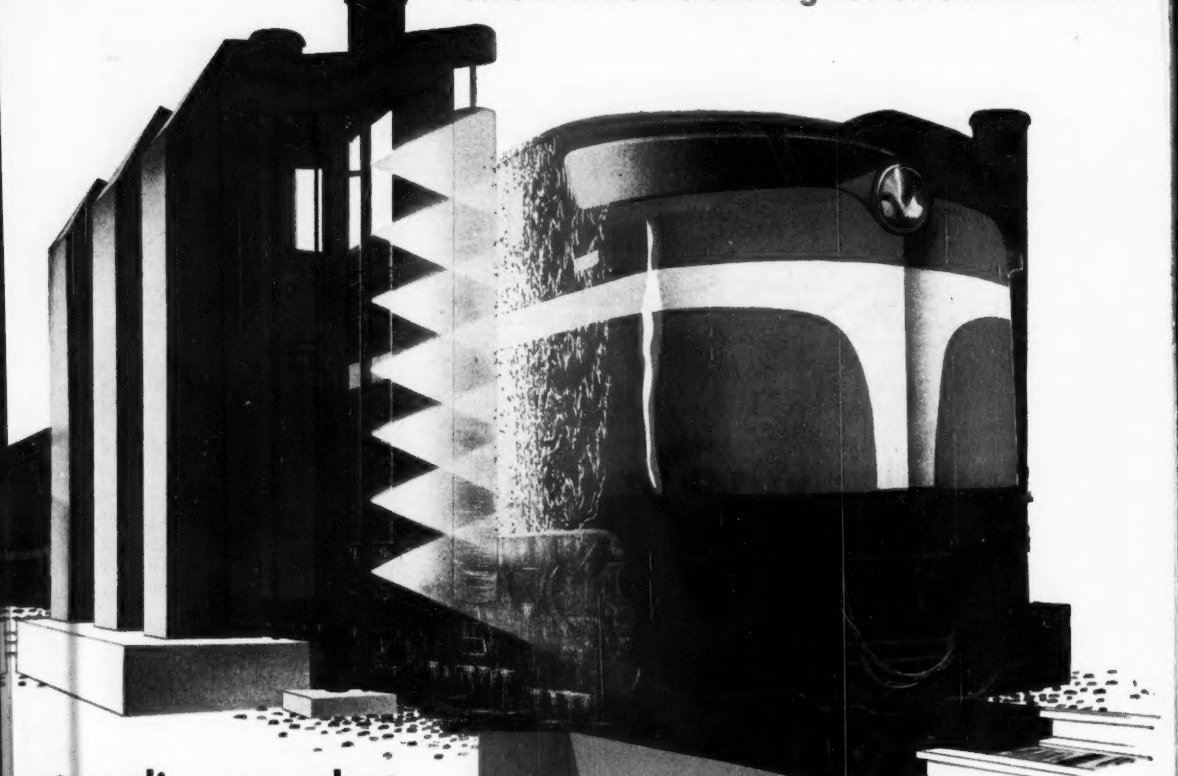
F. H. Ludington: From manager, Philadelphia branch of Chase Bag Co., to assistant vice president.

Herbert S. Wilkinson: From director of sales to board member, Abbott Laboratories.

E. Nelmes Thomas: To assistant manager, Sales Promotion Division, Commercial Solvents Corp.

J. Fred Dudley: To assistant chief engineer, Commercial Solvents.

streamlined cleaning for streamliners!



streamline your sales to the transportation industry with mixtures based on

Nacconol*

AMERICA'S LEADING SYNTHETIC DETERGENT

Trains, trucks, taxis, busses, autos . . . name the field and you'll find streamlined mechanical-cleaning methods growing by leaps and bounds. That puts a premium on mixtures with a liberal content of an efficient synthetic detergent that cleans fast, rinses freely, leaves polished surfaces unstreaked and unharmed.

We'll be glad to suggest NACCONOL "starting formulas" to help you build more sales in this growing field. Write, wire or phone our nearest office for technical help, prices and delivery.

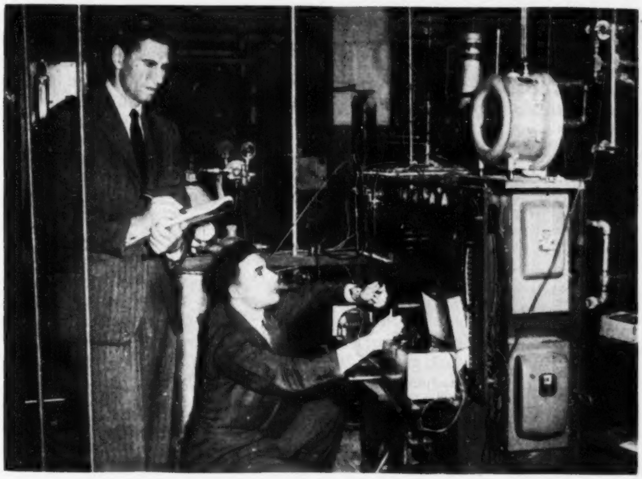
NATIONAL ANILINE DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 RECTOR STREET, NEW YORK 6, N.Y. • BOwling Green 9-2240

Boston 14, Mass., 150 Causeway St.	CApitol 7-0490	Richmond 19, Va., 8 North Fifth St.	Richmond 2-1930
Providence 3, R.I., 15 Westminster St.	DExter 1-3008	Columbus, Ga., Columbus Interstate Bldg.	Columbus 3-1029
Philadelphia 6, Pa., 200-204 S. Front St.	LOmbard 3-6382	Greensboro, N.C., Jefferson Standard Bldg.	GReensboro 2-2518
San Francisco 5, Cal., 517 Howard St.	SUtter 1-7507	Chattanooga 2, Tenn., James Building	CHattanooga 6-6347
Portland 9, Ore., 730 West Burnside St.	Beacon 1853	Atlanta 2, Ga., 140 Peachtree St.	CYPress 2821
Chicago 54, Ill., The Merchandise Mart	SUperior 7-3387	New Orleans 18, La., 714 Carondelet Building	Raymond 7228
Charlotte, 1 N.C., 201-203 West First St.	CHarlotte 3-9221	Toronto 2, Canada, 137-143 Wellington St. W.	Elgin 8485

*Reg. U.S. Pat. Off.



AUTHORS HAPPEL AND MARSEL check operation of their pilot plant, which cracks natural gas to acetylene.

Processes Compete in Acetylene Boom

Fast-growing uses for acetylene-derived chemicals are fixing industry's attention on the various acetylene production processes.

Economic study indicates that thermal cracking of natural gas, followed by Hypersorption purification, may provide the cheapest acetylene — considerably cheaper than from calcium carbide. Regenerative cracking appears to be least costly.

Industry's plans for acetylene-from-hydrocarbon plants support the contention that acetylene's future lies in the Southwest.

John Happel and Charles Marsel*

Production of organic chemicals from acetylene is increasing by leaps and bounds.

Today, practically all acetylene is made by the time-honored carbide process; but considerable research has been done on the production of acetylene from cheap natural gas. Recent developments reveal that some of these processes have now reached commercial stature.

A list of companies doing research on production of acetylene and its derivatives reads like a Who's Who of the chemical industry. It includes Monsanto, Carbide and Carbon, Tennessee Eastman, Du Pont, American Cyanamid, General Aniline and Allied Chemical.

Carbide Process: Carbide furnaces are again being pushed to top capacity to supply necessary acetylene. Some typical production figures are: 1945–675,000 tons; 1948–683,000 tons; 1949–605,000 tons. Preliminary 1950 figures indicate a peak year, 671,402 tons.[1]

In addition, appreciable quantities of carbide are imported from Canada. Of considerable importance also is American Cyanamid's Canadian operation involving the reaction of calcium carbide with nitrogen to form calcium cyanamid.

Table I indicates plant location and estimated capacity for the carbide industry. It must be emphasized that these figures are flexible, since a furnace can be operated at higher production with lowered efficiency if warranted by market price.

An estimated 60-70% of acetylene from carbide finds its way into acetylene chemicals. Other uses for calcium carbide in this country are minor at the present time.

Natural Gas: After many years of research manufacture of acetylene from natural gas has arrived. Two basic steps are involved: pyrolysis of natural gas to produce an acetylene-containing effluent, and recovery and purification of the dilute product contained in the pyrolysis mixture.

Although most attention has been devoted to the primary production

* *Department of Chemical Engineering, New York University, New York, N.Y.*

of acetylene, it appears that a major proportion of the capital and operating costs are involved in its separation.

Table I—Calcium Carbide Industry

Company Plants	*Estimated Potential Capacity, Tons/Year*
Union Carbide and Carbon Co., Electro Metallurgical Division	
Niagara Falls, N. Y.	276,000
Sault Ste. Marie, Mich.	90,000
Ashtabula, Ohio[5]	100,000
Ashtabula, Ohio[2]	81,000
Ashtabula, Ohio	108,000
Sheffield, Ala.	45,000
Portland, Ore.[1]	18,000
Air Reduction Co., National Carbide Division	
Calvert City, Ky.[5]	142,000
Louisville, Ky.	144,000
Ivanhoe, Va.	79,000
Keokuk, Iowa	36,000
Tennessee Valley Authority	
Muscle Shoals, Ala.[3]	80,000
Mid-West Carbide Corp.	
Keokuk, Iowa	40,000
Pacific Carbide and Alloys Co.	
Portland, Ore.	15,000
American Carbide Co.	
Arkansas City, Kan.	3,000
Monsanto Chemical Co.[4]	
Anniston, Ala.	20,000

[1] Production devoted mostly to more profitable ferro-alloys.
[2] Leased from the Government.
[3] In standby condition.
[4] Believed now converted to phosphorus.
[5] Under construction.

Regardless of the process used for the primary cracking step, it is essentially a non-catalytic thermal reaction. To secure reasonably high acetylene yields, temperatures in excess of 2,600 F are necessary, although the optimum conditions have not yet been established. Operation at such high temperatures requires such refractories as alumina or Carborundum.

The conditions required are high temperatures with very short contact times; rapid quenching of reaction products; use of a diluent such as hydrogen or steam; reduced pressures.

The process employed on a large scale at Hüls, Germany,[2] dating from 1938, was the earliest successful commercial process.

Feed gas, mostly methane, is converted in part to acetylene in an electric arc. The crude product gas is purified by cyclone separators, bag filters, oil scrubbing and finally water scrubbing, and the acetylenes concentrated by water under pressure. Higher acetylenes in this concentrate are then separated from acetylene itself by cooling in stages to −108 F and the acetylene-free gas is separated into its components in a Linde liquefaction-distillation plant.

Schoch Process: Since 1942, E. P. Schoch,[3] at the University of Texas, has carried on the development of another electrical process for making acetylene directly from methane. Instead of an arc, a silent electrical discharge forms acetylene from methane. This system has been employed in a pilot plant processing 1,000-2,000 cu. ft. of natural gas per hour. Economic studies indicate that this process would yield acetylene more cheaply than the German method.

Sachse Process: Another process that has received considerable attention is that based on partial oxidation of methane to supply heat to crack the remainder. A semi-commercial plant was operated at Oppau, Germany,[4] for several years until it was destroyed by bombing in 1944. Its operation involved partial combustion of pre-heated methane with oxygen in a specially designed burner; it had been planned to expand the plant and employ a purification system similar to that used at Hüls. The process is fundamentally similar to the partial-combustion stage in the production of synthesis gas from methane.

Hydrocarbon Research, Inc., which has pioneered developments in this country on synthesis gas production from methane, is understood to have obtained pilot plant confirmation of the German results for the Monsanto Chemical Co., is planning to install a process of this type at Texas City, Texas.[5]

Another partial combustion plant is under construction for Carbide and Carbon Chemicals Co. at Texas City,[18] and should be in operation in the near future.

Air Oxidation: Partial combustion using air instead of oxygen has also been proposed. Some pilot-plant work has been done in the United States by the Danciger Oil & Refining Co.

Wulff Process: Considerable study has been devoted to methods where the heat is applied intermittently by regenerative, gas-fired furnaces. No commercial installations of this type exist, but promising pilot-plant work during the past 10 years has been carried out by the Tennessee Eastman Corp.[6] in the United States and by Ruhrchemie, A-G in Germany.[7]

These processes operate at lower temperatures than the arc or internal-combustion systems, and it is essential to maintain a low partial pressure of acetylene in the effluent gases. In the Wulff process[8] studied by Tennessee Eastman, the feed stock is diluted with steam.

Petroleum Chemicals Co. (Air Reduction and Continental Oil) has also studied the Wulff process in a small pilot plant.

The Wulff Process Co. (a holding company for Wulff patents) has itself just launched a small demonstration unit near Los Angeles, Calif., operating its process on natural gas to produce 1 million cubic feet of cylinder acetylene per month. The unit should furnish reliable operating data.[9]

Ruhrchemie employed a vacuum of 70-80 mm. Hg. absolute in a very small pilot-plant scale. Quenching under vacuum and the removal of products under a vacuum seal introduces operational problems, and much more experimental work is necessary.

Both of these regenerative processes appear economically attractive, but uncertainties of design and operation on a large scale appear to be fewer in the case of the Wulff process; this variation has therefore been selected for further evaluation here.

Basic problems in concentration and purification of the dilute gases from these processes are much the same. First, a large quantity of fixed gases (methane and hydrogen) must be removed; secondly, to be usable in most chemical syntheses, the product must be free from olefins and higher acetylenes.

The German technique of using water scrubbing under pressure is believed to be less economical, because of multi-stage operation and large size of towers involved, than the use of selective solvents or hypersorption. However, Monsanto reportedly is to use water scrubbing in its Texas operations, possibly because use of previous know-how developed by the Germans will save time.

Solvent Purification: The ideal selective solvent would have these properties: low cost, high acetylene solubility, high selectivity for acetylene, high boiling point, low molecular weight, and high thermal stability. Some of the solvents proposed include "Cellosolve,"[10] acetone,[11] triethyl phosphate, dioxane,[12] furfural,[13] dimethoxytetraethylene glycol,[3] and dimethylformamide.[14] The latter appears most attractive because of its high solubility and excellent selectivity for acetylene. It is the solvent used in the following comparative studies.

Hypersorption: Hypersorption, the other alternative method considered here, involves the use of a moving bed of charcoal. This process[15] shows great promise as a means of effectively separating hydrocarbon components present in low concentrations in fixed gas streams. It has been used commercially for recovery of ethylene and natural gasoline fractions, and for purification of methane in a natural gas stream.

Summarizing, four primary production processes have been examined. (1) electric arc, (2) partial oxidation with oxygen, (3) partial oxidation with air,

and (4) thermal pyrolysis using regeneration. Two purification processes have been considered: (1) hypersorption, and (2) solvent extraction.

Descriptions of these processes follow, based on production of 20 million lbs./yr. of acetylene and concentration to 99% purity. A typical Gulf Coast natural gas (84% methane) is assumed as the raw material. Its analysis, and that of the effluents from the various primary production processes studied in detail here are given in Table II.

Basis for Economic Analysis: Capital investment includes the delivered and erected cost of all equipment, as well as the required auxiliaries. Utilities are assumed to be purchasable at property limits at prices indicated, in order to avoid charging as capital costs such items as power plants. Factors such as working capital are not included, in order to provide for the simplest possible analysis. Final cost of the acetylene provides for 10% profit and 10% depreciation on capital investment after 47% federal taxes.

Table II—Analyses of Feed to and Effluent From Acetylene Process

Production Units

		Effluent Gas			
Mol %	*Feed Natural Gas*	*Schock*	*Oxygen Oxidation*	*Air Oxidation*	*Wulff*
H_2	....	42.2	51.3	24.3	61.4
N_2	....	....	1.6	54.2	....
CO	....	2.1	26.3	9.4	3.5
O_2	....	....	....	....	....
CH_4	84.3	39.2	5.8	3.6	22.6
CO_2	4.3	1.0	5.9	3.5	1.5
C_2H_2	....	9.9	8.5	3.5	9.0
C_2H_4	....	0.5	0.1	0.2	0.9
C_2H_6	6.8	2.2	....	1.0	0.2
C_3H_4[a]	....	0.7	0.4	0.2	0.5
C_3+[b]	4.6	2.2	0.1	0.1	0.4
	100.0	100.0	100.0	100.0	100.0

[a] Includes heavier acetylenes
[b] Includes heavier paraffins and olefins

CARBIDE PROCESS

PRO	**It is a technically proved process, having been in successful use for many years.**
	Carbide is convenient to ship and store as raw material for ready acetylene generation.
	By purchasing carbide, the only capital investment required is that for hoppers and generating facilities.
CON	**The process has apparently reached a static technical state, with little change of any major process improvements. Any substantial lowering of cost in the process must be accomplished by lower power and/or raw material costs.**
	It is difficult to find a location where both power and quality raw materials are cheap and available.
	Power supply is currently very tight, and it is doubtful if large blocks of power could be purchased for expanded production. Capital investment requirements for a power plant are high.

CARBIDE

Carbide Production: In the manufacture of calcium carbide, lime and coke are charged to an electric arc furnace, where at 2,000-2,100 C, the lime is reduced and converted to carbide.

$$CaO + 3C \rightarrow CaC_2 + CO$$

Raw materials must be carefully selected to insure maximum furnace efficiency and product purity. The lime, for example, should be essentially free of phosphates and magnesium carbonate, and of the proper physical characteristics for handling and crushing; the coke should have a low ash content.

After processing the lime and coke to the proper dryness and physical size, the mixed materials are fed automatically to the furnace. The carbon electrodes are gradually consumed as the operation proceeds. Liquid carbide, tapped either intermittently or continuously, is solidified by cooling 24-48 hours, and subsequently crushed and screened. The carbide so produced is about 80-85% pure; one lb. of carbide yields about 0.32 lbs. (4.6 cu. ft.) of acetylene.

The ideal carbide plant location is naturally one in which suitable limestone, coke, power and markets are all found in the same area. Greatest influence is power, since it represents the largest single item of production cost, and is not amenable to efficient transmission. Niagara Falls, for example, with its cheap power, is an excellent area for carbide production.

Sources of limestone (or lime), coke and coal are also of great importance, since the cost of shipping raw materials must be kept low. Quality of raw materials must also be kept high. For example, Gulf Coast limestone, from such sources as oyster shells, is not suitable for carbide manufacturing; excessive fines formation hinders CO passage through the bed. Many carbide manufacturers prefer to purchase lime directly.

Petroleum coke is a superior source of carbon because of its low ash and high resistivity and is quite generally used in combination with coal coke.[9] Use of inferior coke gives correspondingly poorer yields of carbide.

The smallest economic carbide furnace is about 50 tons/day capacity, or about 6,000 kw. Furnaces range up to 25,000 kw, indicating a trend toward larger furnaces. The Germans operated furnaces of 30,000-35,000 kw.

Acetylene is generated from carbide by reaction with water:

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

Care must be exercised because of the potential explosion danger.

Wet and Dry: Two standard methods for producing acetylene are called the wet and dry process. The wet process consists of dropping the carbide at a measured rate into a large quantity of water. Calcium hydroxide is discharged in the form of a lime

Table III—Estimated Acetylene Cost, Carbide Process

Plant capacity, lbs./yr. of acetylene	20,000,000
Tons of 80% calcium carbide produced	31,000
A. Calcium carbide production[a]	
1. Capital investment	
a. Raw material preparation	$ 341,000
b. Carbide furnaces	830,000
c. Soderberg electrodes	123,000
d. Carbide crushing	64,000
e. Total investment	$1,358,000
2. Raw materials and utilities	
a. Lime: 0.95 ton/ton CaC_2 @ $13/ton of lime	$ 383,000
b. Coke: 0.60 ton/ton CaC_2 @ $15/ton of coke	279,000
c. Electrodes: 40 lbs/ton CaC_2 @ 8¢/lb	99,000
d. Power: 3,000 kwh/ton CaC_2 @ 0.35¢/kwh[b]	326,000
	$1,087,000
3. Direct labor: 2.5 man-hrs./ton CaC_2 @ $2.00/man-hr.	155,000
4. Works overhead at 100% of direct labor	155,000
5. Maintenance & fixed charges @ 9% of capital investment	122,000
6. Operating cost	$1,519,000
7. Annual gross earnings required for 10% profit, 10% depreciation and 47% Federal taxes	$392,000
8. Total cost of carbide manufacture	$1,911,000
a. Cost as $/ton of 80% carbide	$ 61.80
b. Coast as ¢/lb of acetylene	9.55
B. Acetylene generation[c]	
1. Capital investment	$ 425,000
2. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes	$ 123,000
a. Capital cost as ¢/lb of acetylene	0.61
3. Utilities (estimated)	$ 2,000
4. Direct labor: 5 men/shift @ $2.00/hr.	92,000
5. Works overhead at 100% of direct labor	92,000
6. Maintenance & fixed charges @ 9% of capital investment	38,000
7. Operating cost	$ 224,000
a. Operating cost as ¢/lb of acetylene	1.12
b. Acetylene generation total cost as ¢/lb of acetylene	1.73
c. Total cost of production as ¢/lb of acetylene	11.28

[a] If power plant is required, make [illegible] $692,000 for amortization (10 years) and add cost of fuel.
[b] For each 0.1 ¢/kwh price increase add 0.46 ¢/lb to cost of acetylene.
[c] If carbide must be shipped, add 0.54 ¢/lb to cost of acetylene in addition to freight charges, to provide for hoppers used in transit.

FROM NATURAL GAS	
PRO	Low raw material cost in Texas and along natural gas pipelines.
	Trend toward large-scale production and installation of end-product plants in the region of cheap raw materials.
	Technological advances with respect to both producing and concentrating acetylene from gas mixtures.
CON	Low concentration of acetylene in the product gas, creating an expensive concentration problem.
	Difficulty of separating and concentrating acetylene as a result of the variety of products formed: olefins, higher acetylenes, aromatics, and carbon.
	Lack of cheap hydrocarbon raw material in highly industralized areas, as compared to the general availability of limestone and coke required for calcium carbide.
	Necessity of installing acetylene-consuming plants in the vicinity of the acetylene generating plant, as compared to the convenience of transporting calcium carbode to the acetylene consumer.
	Higher capital investment required, compared with installation of acetylene generating units from carbide.
	Need for further experimental investigation.

slurry containing about 90% water. If one wants to recover and reuse the lime, or sell it, this presents a problem.

The dry process uses a limited amount of water (1:1 by weight), in which case the heat of reaction (166 Btu/cu. ft. acetylene) vaporizes the excess water, leaving a substantially dry calcium hydroxide, either for recycling or sale, with consequent savings. But temperature must be carefully controlled in the process to avoid acetylene polymerization or decomposition. This is done by continuous agitation.

Generators of both types are usually designed to operate below 15 psig. and 300 F. The crude gas, containing traces of hydrogen sulfide, ammonia and phosphine, is purified by scrubbing with water.

Improvements in process design and operation include the trend to larger furnaces, utilization of waste heat from by-product gases by means of "closed" furnace construction, and recycling of the calcium hydroxide by-product.

There has been a trend toward on-the-spot carbide production and acetylene generating plants to supply nearby users. If raw materials and power are available, this is economically desirable because it eliminates the cost of shipping calcium carbide. However, rail-shipped carbide is still a major source of acetylene.

For large-scale users of acetylene, the 100-lb. drum has been replaced as a shipping container by the 5-ton nominal capacity hopper, twelve of which fit on a railroad hopper car. These containers, because they are designed to couple directly to the feed intake of a generator, also serve as the acetylene feed hopper. They must be furnished by the consumer.

HYDROCARBONS

Schoch Process: The electric discharge employed is essentially a low-temperature, widely disseminated arc and results in the production of acetylene from natural gas at a concentration of about 10%. Production of 20 million lbs. per year of acetylene with a 90% on-stream efficiency will require 267/Mscf hr. of natural gas.

The gas enters the first of six electrical reaction chambers at about 10-15 psi and then proceeds through the remaining five chambers in series. Each of the reaction chambers contains three discharges operating in parallel, each with a power rating of 770 kw.* The feed gas is introduced into the eye of a rotating impeller (very similar to a closed centrifugal blower impeller) and is discharged through three openings spaced 120° apart on the outer periphery of the casing. Each of the three electrical discharges is formed between the impeller, acting as one electrode, and a stationary electrode mounted outside each opening in the casing.

Since about 60% of the discharge energy is liberated as sensible heat, the chamber temperature is limited to 550 F by recirculation of the gas through a cooler after preliminary removal of carbon black by a cyclone. The 395/Mscf hr. of product gases leaving the final chamber are cooled to about 100 F, and the remaining carbon black is removed by bag filters.

The carbon black collected in the cyclones on the recirculated gas streams, together with that collected in the bag filters, is carried by a gas stream furnished by small blowers to a central collection cyclone and storage bin. A helical screw and casing is attached to the bottom of the bin to compress the carbon into a dense plug and to deliver this plug outside to a suitable receptacle. The marketability of this black has not as yet been completely determined. About 250 lb./hr. will be produced.

A spare electrical reaction chamber is provided as well as a spare cooler for the recirculaing gases. The vertical intercooler tubes are constantly scraped to prevent their being covered with carbon black.

*The power delivered to the discharges must be at a constant current regardless of changes in the impedance of the path; this is obtained from the constant potential electrical power supply by use of the Steinmetz T-circuit. Three-phase, 60-cycle power is transformed to a secondary voltage of about 15,400 volts; this is then delivered to the T-circuit controls. Each discharge then operates at 770 kw with a potential of about 8,500 volts and a discharge power factor of 0.75.

SCHOCH PROCESS	
PRO	Production of by-product carbon black which may have a use in the rubber industry.
	Future research and development offers possibility of reduced power requirement. Thermodynamic calculations indicate a minimum theoretical requirement of electrical energy of 1.8/lb. of acetylene as compared with the actual power requirement of about 5.5kwh/lb. by both the Schoch and German arc processes.
CON	Complicated operation. In addition to mechanical difficulties with the arc, there have been problems in heat removal, recycling diluent gases and low-pressure operation.
	So far, no electrical process has shown a lower power requirement than the carbide requirement of 4.5 kwh/lb. of acetylene produced.

	SACHSE PROCESS
PRO	**Elimination of electrical power cost. This is roughly equivalent to 1¢/lb. of acetylene.** **Production of Fischer-Tropsch synthesis gas as a by-product.**
CON	**An oxygen plant, representing a further substantial investment, must be constructed.** **No substantial pilot-plant experience is available on recovery problems which may be encountered as a result of trace impurities of oxygenated by-products.**

Sachse Process: For 20 million lbs./-yr. of acetylene with a 90% on-stream efficiency, 217 Mscf/hr. of natural gas and 142 Mscf/hr. of oxygen (95% pure) are required. For a pure methane feed the required ratio of hydrocarbon to oxygen is about two to one, but more oxygen is required for heavier hydrocarbons.

The natural gas and oxygen are separately preheated to 750 F before entering the acetylene production burner. The burner contains a mixing section, a combustion section and a water quenching arrangement. The very efficient mixing, which is required, is obtained by passing the gases through two banks of flame trap tubes. These tubes are of small diameter and so designed that the gas velocity through them is greater than the critical extinction velocity of the reaction, thus preventing back-fire from the combustion zone. A gas velocity of 30 ft./sec. is maintained in the combustion zone and the reaction time is of the order of 0.01 sec. A reaction temperature of 2,700 F is obtained in the combustion zone, after which the effluent gas is quickly cooled by water sprays. Based on German design, the plant requires seven burner units, each with a combustion chamber 27" in diameter by 13.5" in length. The 450 Mscf/hr. of product gas is passed through a quench tower and a Cottrell precipitator before delivery to the acetylene purification unit. The concentration of acetylene in this final gas will be about 8.5%-9%.

	AIR OXIDATION
PRO	**Oxygen plant investment is avoided.**
CON	**Effluent gas is more dilute in acetylene, requiring more expensive recovery facilities.** **By-product gases cannot be used for synthesis gas unless additional equipment is installed for separation of hydrogen and nitrogen.**

Air Oxidation: Production of acetylene by partial combustion of natural gas with air is similar to the Sachse process. Air is used instead of oxygen and higher pre-heat temperatures are required. Final effluent gases contain only 3.5% acetylene; but no costly oxygen production facilities are required.

For the production of 20 million lb./yr. of acetylene with a 90% onstream efficiency, 250 Mscf/hr. of natural gas and 775 Mscf/hr. of compressed air are required. Both the air and natural gas are separately preheated to 1500 F before introduction into the burners, seven of which are required. Mixing, combustion, quenching and subsequent cleaning of the 1,125 Mscf/hr. of effluent gas are accomplished similarly to that described above for the Sachse process.

	WULFF PROCESS
PRO	**Elimination of electrical power cost.** **Possible improvement. Research is being continued on this process by Tennessee Eastman Corp.; and it is understood that improved operation is possible using a combination of partial combustion and regenerative stove cracking.**
CON	**The mechanical construction of the regenerative stoves is complicated. There is some question as to whether the refractories used will stand up under prolonged operation at the temperature conditions employed. At any rate, maintenance cost will be high. Proposed commercial equipment will involve a unit furnace size fifteen times that for pilot-plant operation.** **Unless the highest temperatures can be reached, a high proportion of ethylene will be obtained, thereby requiring markets for both ethylene and acetylene.** **Concentration and purification of acetylene is complicated by the high proporation of ethylene.**

Wulff Process: Licensed by the Wulff Process Co., it consists of thermally cracking natural gas at 2,600 F in a regenerative furnace.

To produce 20 million lb./yr. of acetylene, 272 Mscf/hr. of natural gas is fed alternately in about one-minute cycles to each of the two regenerative-type cracking furnaces. Each furnace consists of packed sections with a total cross-sectional area of 30 sq. ft., mostly filled with Carbofrax brick, manufactured by the Carborundum Co. In the highest-temperature zone, aluminum oxide brick is used. Spaces between the bricks are used for gas flow and are designed to obtain about 0.04 seconds residence time.

During the cracking phase of the cycle, natural gas is introduced at the bottom of the furnace. In passing up between the previously heated brick, it is heated to cracking temperature. It then passes down through the other side of the furnace, where it is rapidly cooled (0.02 sec.) to about 500 F by giving up heat to the other bricks. The effluent gas then enters the gas wash box, which further cools it and also serves as a water-sealed shutoff valve. The stack is closed by the cap valve on top, and the effluent flows through the gas wash box to the quench tower.

Table IV—Estimated Acetylene Cost, Schoch Process

Plant capacity, lbs./yr. of Acetylene....	20,000,000
1. Capital investment..............	$ 700,000
2. Utilities	
a. Natural gas feed 267 Mscf/hr. @ 15¢/Mscf..................	320,000
b. Cooling water 2130 gpm (25 C rise) @ 3¢/M gal..............	31,000
c. Steam (internally produced).....	......
d. Electricity, 14,325 kwh @ 0.7¢/kwh[a]......................	800,000
	$1,151,000
e. Credit for fuel gas produced 231 MM Btu/hr @ 15¢/MM Btu	−277,000
f. Net utility cost................	$ 874,000
3. Labor and supervision: Two men/shift @ $2.00/man-hr............	37,000
4. Works overhead @ 100% of labor and supervision	37,000
5. Maintenance and fixed charges @ 9% of capital investment	63,000
6. Operating cost....................	$1,011,000
a. Operating cost as ¢/lb of acetylene	5.05
7. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes...............	202,000
a. Capital cost as ¢/lb. of acetylene..	1.01
8. Total cost of production of acetylene..........................	$1,213,000
a. Total cost (exclusive of purification) as ¢/lb. of acetylene........	6.06

[a] A change of 0.1 ¢/kwh causes a change of 0.57 ¢/lb. in acetylene cost.

Meanwhile, the other furnace is operating on the heating phase of the cycle. Hot flue gas from burners in the top of the furnace now passes down the first side of the furnace (used for cracking in the other phase of the cycle) where it heats the brick. It then passes up the stack, whose cap valve is open. Combustion air for the burner is used to cool the other side of the furnace (used for cooling the cracked effluent during the other phase of the cycle). The valve in the gas wash box of this furnace is closed to prevent flow to the quench tower. The cycles are then alternated about once a minute.

HYPERSORPTION SEPARATION	
PRO	The high selectivity of carbon for C_2 hydrocarbons as compared with fixed gases (hydrogen and methane) makes this process attractive for concentration of the dilute acetylene streams resulting from pyrolysis. High pressure operation can be avoided. This is important because of the hazard of handling acetylene-containing gases.
CON	Problems connected with the presence of high-boiling substituted acetylenes in the pyrolysis effluent are still not completely known. Main points for study are the extent of polymerization of higher acetylenes on the carbon, and extent and degree of carbon reactivation necessary.

Table V—Estimated Acetylene Cost of Sachse Process

Plant capacity, lbs./yr. of acetylene	20,000,000
1. Capital investment	
a. Acetylene plant	$ 450,000
b. Oxygen plant	1,750,000
c. Total	$2,200,000
2. Utilities	
a. Natural gas feed, 217 Mscf/hr. @ 15¢/Mscf	260,000
b. Cooling water (25 C rise), 1225 gpm total @ 3¢/M gal.	18,000
1) Acetylene plant...1120 gpm	
2) Oxygen plant..... 105 gpm	
c. Steam (oxygen plant only), 3000 lb/hr @ 35¢/M lbs.	8,000
d. Electricity, total 2390 kw @ 0.7¢kwh[a]	134,000
1) Acetylene plant... 40 kw	
2) Oxygen plant....2350 kw	
e. Fuel gas consumed, 5.85 MM Btu/hr. @ 15¢/MM Btu	$ 7,000
	$ 427,000
f. Credit for fuel gas produced, 129 MM Btu/hr.	−155,000
g. Net utility cost	$ 272,000
3. Labor and supervision, 2 men/shift @ $2.00/man-hr.	37,000
4. Works overhead @ 100% of labor and supervision	37,000
5. Maintenance and fixed charges @ 9% of capital investment	199,000
6. Operating cost	$ 545,000
a. Operating cost as ¢/lb. of acetylene	2.72
7. Annual gross earnings required for 10% profit, 10% depreciation and 47% Federal taxes	$ 636,000
a. Capital cost as ¢/lb. of acetylene	3.18
8. Total cost	$1,181,000
a. Total cost (exclusive of purification, as ¢/lb. of acetylene	5.90

[a] A change of 0.1¢/kwh causes a change of 0.1¢/lb. in acetylene cost.

Carbon will be produced during the cracking phase, and most of it will be deposited on the brick; its combustion during the heating cycle supplying part of the required heat. The remaining carbon is recovered in the effluent water from the quench tower and gas wash boxes. Carbon production will amount to about 125 lb./hr.

The 442 Mscf/hr. of effluent gas from the spray tower is then passed through a Cottrell precipitator for final cleaning before transmission to the acetylene purification unit.

Pilot plant operations at Baltimore, Md., and Kingsport, Tenn., have been conducted on propane, butane, stabilizer and refinery gases, but natural gas data are available only for small-scale (10 cu. ft./hr.), Carborundum, externally heated tubular equipment.

SEPARATION

Hypersorption: The hypersorption process utilizes a moving bed of activated carbon to separate a gas mixture into its components by selective adsorption. This process is licensed by the Union Oil Co. of Calif.

The effluent gas produced from any of the four preceding acetylene production processes is compressed from atmospheric pressure to 45 psig for introduction into the hypersorber, which consists of a tower filled with granular activated carbon.

Feed gas is contacted with the carbon in the center of the tower, and the heavier components of the feed are selectively adsorbed and carried down the tower with the carbon, which is continually removed from the bottom of the tower at a controlled rate and returned to the top by a gas lift system. Stripping steam, introduced at a lower point, strips essentially all the adsorbed components from the carbon, and these are removed as bottoms product.

The carbon then passes through the tubes of a vertical-tube bundle externally heated by condensing Dowtherm vapor; this strips off most of the adsorbed steam. The hot stripped carbon is then carried to the top of the tower, where it is cooled by passing through a tube bundle externally cooled by water, after which it enters the adsorption section to complete the cycle.

Lighter components of the feed gas are essentially unadsorbed and pass up through an adsorption section where any remaining traces of the heavy components are caught. Most of these lighter components are then removed below the cooling section as overhead product.

The remaining part of the lighter components pass up through the cooling section countercurrent to the carbon flow and serve completely to dehydrate the carbon. This vapor serves as the basis of the circulating lift gas, and is removed as purge gas.

In this operation, the acetylene—contaminated only with ethylene, ethane, and part of the carbon dioxide—is recovered in a side cut from the hypersorber. The overhead product and purge gas contain methane, hydrogen, the remainder of the carbon dioxide and inert gases. The bottoms product contains all the propylene, propane, and heavier hydrocarbons, as well as all the substituted acetylenes and stripping steam.

The bottoms product is cooled with steam condensation in the spray tower, which also serves to remove any traces of carbon dust. The cooled product is then recycled to the feed of the acetylene production unit.

The purge gas is also cooled and

Table VI—Estimated Acetylene Cost, Air Oxidation Process

Plant capacity, lbs./yr. of acetylene	20,000,000
1. Capital investment	$ 600,000
2. Utilities	
a. Natural gas feed, 250 Mscf/hr. @ 15 ¢/Mscf	300,000
b. Cooling water, 5620 gpm @ 3 ¢/M gal.	81,000
c. Steam (internally produced)	....
d. Electricity, 40 kw @ 0.7 ¢/kwh	2,000
e. Fuel gas consumed, 43.3 MM Btu/hr. @ 15¢/MM Btu	52,000
	$ 435,000
f. Credit for fuel gas produced, 170 MM Btu/hr. @ 15 ¢/MM Btu	$ 204,000
Net utility cost	231,000
3. Labor and supervision	
a. Two men/shift @ $2.00/Man-hr.	37,000
4. Works overhead @ 100% of labor and supervision	37,000
5. Maintenance and fixed charges @ 9% of capital investment	54,000
6. Operating cost	$ 359,000
a. Operating cost as ¢/lb. of acetylene	1.80
7. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes	173,000
a. Capital cost as ¢/lb. of acetylene	0.87
8. Total cost (exclusive of purification)	173,000
	$ 532,000
a. Total cost as ¢/lb. acetylene	2.67

cleaned in a spray tower and is then added to the remainder of the overhead product which has been scrubbed in a Cycoil oil scrubber. This product can then be used as fuel gas.

A small side stream of carbon is passed through a high-temperature reactivator for removal of any very heavy components entering with the feed gas, or any polymers formed. The nature of possible polymers and their removal from the carbon is currently being investigated.

Table VII—Estimated Acetylene Cost, Wulff Process

Plant capacity, lbs./yr. of acetylene	20,000,000
1. Capital investment	$ 500,000
2. Utilities	
a. Natural gas feed, 272 Mscf/hr. @ 15 ¢/Mscf	326,000
b. Cooling water, 260 gpm @ 3 ¢/M gal	4,000
c. Steam (internally produced)	......
d. Electricity, 40 kw @ 0.7 ¢/kwh	2,000
e. Fuel gas consumed: 64.6 MM Btu/hr. @ 15 ¢/MM Btu	78,000
	$ 410,000
f. Credit for fuel gas produced, 185 MM Btu/hr. @ 15¢/MM Btu	222,000
g. Net utility cost	$ 188,000
3. Labor and supervision	
a. Two men/shift @ $2.00/man-hr	37,000
4. Works overhead @ 100% of labor and supervision	37,000
5. Maintenance and fuel charges @ 9% of capital investment	45,000
6. Operating cost	$ 307,000
a. Operating cost as ¢/lb. of acetylene	1.54
7. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes	144,000
a. Capital cost as ¢/lb. of acetylene	0.72
8. Total cost (exclusive of purification)	$ 551,000
a. As ¢/lb. of acetylene	2.26

The C_2 sidecut is also cleaned in a Cycoil and is then introduced into a rectified solvent extraction tower for final acetylene purification.

The solvent extraction tower utilizes DMF (dimethyl formamide) as solvent and has 50 trays. Heat of absorption released in the upper section of the tower is removed by two refrigerated side stream coolers. The absorber overhead product, which consists of all compenents of the hypersorber sidecut (ethylene, ethane and carbon dioxide) except the acetylene, is stripped of entrained DMF and returned to the tower. This gas can then be added to the fuel system or recycled to the production unit feed if the carbon dioxide content is not too high.

The DMF containing dissolved acetylene is withdrawn from the bottom of the absorber and passed into a reboiler, in which it is heated to 40 F by heat exchange with the final stripper DMF. Most of the absorbed acetylene is stripped from the DMF here; the remainder is stripped in a second reboiler at 150 F. Part of the stripped acetylene is returned to the bottom of the extraction tower as reflux to strip any other components from the DMF; while the remainder is cooled to 2 F to cause condensation and return of any entrained DMF vapor. This acetylene, the final product, now has a purity of 99%.

SOLVENT EXTRACTION

PRO

- It uses conventional fractionating and heat exchange equipment.
- Methods of design, based on available equilibrium data for the solvent, are well established.

CON

- Solvents have not been used commercially in the extraction and purification of acetylene.
- Difficulties may arise in reconditioning of solvent to remove various high-boiling and reactive contaminants.

The hot stripped DMF from the second reboiler is cooled to 2 F for return to the top of the extraction tower. The refrigeration system utilizes ammonia evaporating at –20 F with final condensation in a water cooled exchanger at 125 F.

Solvent Extraction: In this acetylene purification unit, the rectified-solvent extraction tower is utilized to concentrate the dilute acetylene pyrolysis effluent (3.5%-9.9% acetylene) to the final product purity of 99%. This requires a much larger tower and greatly increased solvent circulation as compared to the small tower utilized for the final purification after hypersorption. Operating conditions of temperature and pressure (35 psig) as well as the general design and operation are the same as discussed under hypersorption.

However, since the heavier acetylenes are perferentially absorbed with respect to acetylene, these must be removed by an oil wash system previous to solvent extraction; otherwise the final acetylene product would be impure. In addition, some polymerization of these components takes place, contaminating the solvent and necessitating its frequent purification by redistillation. In hypersorption the solvent tower is protected, for the hypersorber removes heavy components in addition to light components.

To remove heavier components in this operation, the production unit effluent is compressed from atmospheric pressure to 110 psig for introduction into the oil wash tower. Three-stage compression is used to prevent excessive gas temperatures, which promote polymerization. The oil wash is designed to remove all C_3 and heavier hydrocarbons as well as all heavier acetylenes from the pyrolysis mixture. The overhead from this tower, after first passing through a stationary bed carbon adsorber, can then be introduced into the solvent extraction tower. The carbon removes traces of entrained petroleum oil, which would otherwise contaminate the solvent.

Removal of dissolved components from the oil leaving the oil wash tower poses several problems: The dissolved higher acetylenes will polymerize if the oil is heated. It is also desirable that as much of the higher-molecular-weight hydrocarbon fraction as possible be recycled to increase acetylene production efficiency. In addition, the appreciable amount of acetylene dissolved in the oil must be recovered.

These are solved by first reducing the oil to atmospheric pressure, which results in extensive flashing of the lighter components. The natural gas feed to the acetylene production unit is then used to strip the oil further;

Table VIII—Estimated Acetylene Purification Costs, Hypersorption

(Annual production rate: 20 Million lbs. of Acetylene)

	Arc	*Oxygen Oxidation*	*Air Oxidation*	*Wulf*
1. Capital investment	$1,450,000	$1,425,000	$2,450,000	$1,400,000
a. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes	419,000	411,000	718,000	404,000
b. Capital cost as ¢/lb. of acetylene	2.10	2.06	3.59	2.02
2. Utilities				
a. Fuel gas @ 15 ¢/MM Btu	48,000	48,000	90,000	48,000
b. Cooling water @ 3 ¢/M gal	25,000	26,000	52,000	25,000
c. Steam @ 35 ¢/M lbs	12,000	12,000	17,000	12,000
d. Electricity @ 0.7 ¢/kwh	8,000	8,000	13,000	8,000
	$ 93,000	$ 94,000	$ 172,000	$ 93,000
3. Labor and supervision				
a. Two men/shift at $2.00/man-hr	37,000	37,000	37,000	37,000
4. Works overhead @ 100% of labor and supervision	37,000	37,000	37,000	37,000
5. Maintenance and fixed charges @ 9% of capital investment	130,000	128,000	220,000	126,000
6. Carbon and chemical make-up	21,000	20,000	40,000	20,000
7. Operating cost	$ 318,000	$ 316,000	$ 506,000	$ 313,000
8. Operating cost as ¢/lb. of acetylene	1.59	1.58	2.53	1.56
9. Total purification cost as ¢/lb. of acetylene	3.69	3.64	6.12	3.58

the natural gas leaving the top of this tower then becomes the feed to the acetylene production unit.

The oil is then heated slightly and again flashed, and the gas from both flashing operations is returned to the acetylene production plant. The small amount of residual material in the warm oil is finally stripped in the waste gas stripper by a part of the extraction tower overhead gas. This waste gas can then be returned to the extraction tower overhead gas stream with a compressor, or can be used as fuel gas.

In this process, the solvent extraction tower overhead contains the same components as the combined hypersorber overhead, purge gas, and extraction tower overhead.

PROCESS COMPARISON

A study of the acetylene-from-hydrocarbon processes outlined with the accompanying chart indicates that for a 20 million lb.-a-year plant on the Gulf Coast, the optimum combination of pyrolysis and purification steps is the Wulff process plus hypersorption. This combination gives a price for acetylene of 5.34¢/lb. at the Gulf Coast for a 20 million lb./yr. production with gas at 10 ¢/M cu. ft.

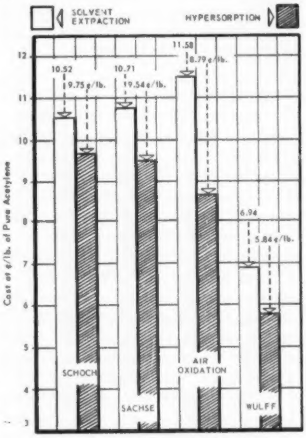
Acetylene from natural gas (10¢/M cu. ft.) via Wulff process plus hypersorption will cost 7.13¢/lb. (10 million lb./yr.); 3.76¢/lb. (50 million lb./yr.) Natural gas at 15¢/M ups these values 0.53¢/lb.

Of course, in an area of lower electricity cost than the Gulf Coast, the Schoch process would be in a more favorable position, although natural gas costs would probably be higher. Evaluation of pyrolysis, and purification steps in terms of normal utility variations nevertheless indicates that the Wulff-hypersorption combination is still the optimum.

A change of 0.1 ¢/kwh in price of power changes acetylene costs for the various process as follows:

Process	*Cost Change, ¢/lb. acetylene*
Schoch	0.57
Sachse	0.10
Air oxidation	negligible
Wulff	negligible

For the carbide process, an increase of 0.1 ¢/kwh in the power price will increase the cost of acetylene by 0.46 ¢/lb.



NATURAL GAS ACETYLENE PRODUCTION COSTS
(20,000,000 lbs./yr. plant)
Comparison of Alternate Process for 20,000,000 lbs. per year of Pure Acetylene

The important question is, What are the economic factors dictating a choice between acetylene production based on carbide as compared to natural gas? In the latter case, acetylene cost depends on plant location and size, and cost of natural gas and utilities. In the case of the carbide process, one has the choice of producing carbide and generating acetylene directly; or purchasing carbide, paying for freight costs, and then generating the acetylene. These possibilities are in addition to the usual variations introduced by varied plant sizes, utilities and raw material costs

On the Gulf Coast, both production or purchase of carbide is prohibitively expensive; acetylene would have to be made from natural gas. On the East Coast at the present time, carbide would still be the preferred route to acetylene. However, intermediate regions which are close to both natural gas pipelines and reasonably priced raw materials and utilities for carbide production would require an economic study for a process decision.

The region of Louisville, Ky., is an example of a location requiring such a study:

Case A is the purchase of carbide, its shipment to Louisville and acetylene generation. Costs include freight, generating facilities and shipping containers.

Case B is the manufacture of carbide and subsequent acetylene generation.

Case C is acetylene from natural gas via Wulff process and hypersorption, with the gas at 30 ¢/M cu. ft.

The cost of acetylene for the three cases varies from a high of 13.77¢/lb. for Case A (carbide at $74/ton) to a low of 6.90¢/lb. for Case C (natural gas at 30¢/M cu. ft. For Case B acetylene will cost 11.97¢/lb (carbide at $66/ton).

However, since the greater part of acetylene produced is converted into chemicals, the final economic analysis must be in terms of the chemicals produced and their sale in consuming areas.

ACETYLENE CHEMICALS

It is estimated that in 1950 at least 300 million lbs. of acetylene was converted into chemicals:

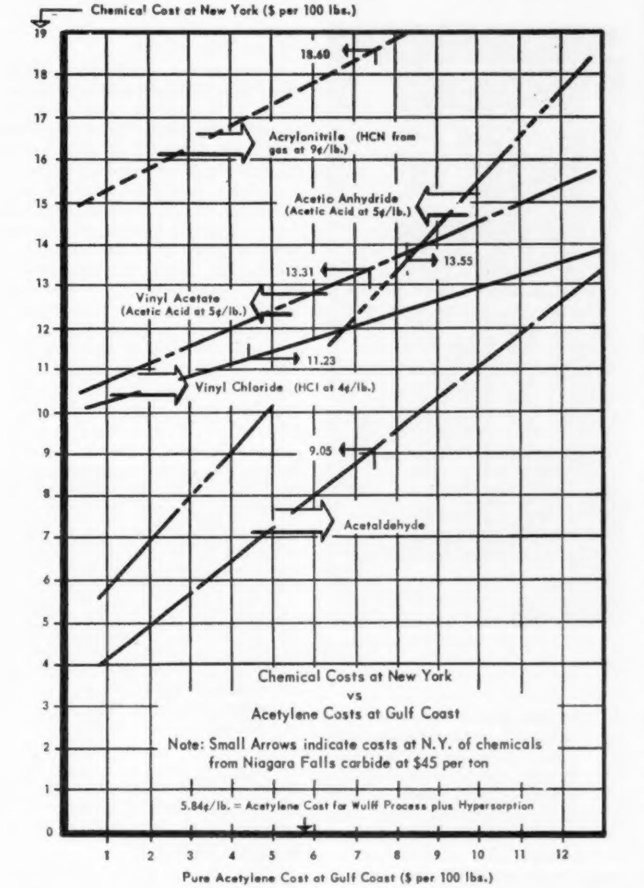
Vinyl acetate: Acetic acid is added to acetylene via a liquid phase process, with mercuric salts as catalyst; addition of a second mole of acetic acid gives ethylidene diacetate. In 1949 21.3 million lbs.[16] of polyvinyl acetate was produced. An additional considerable quantity of vinyl acetate is co-polymerized with vinyl chloride. Polyvinyl acetate is also the starting material for polyvinyl alcohol, formal and butyral. Listed manufacturers are Carbide & Carbon, Du Pont and Shawinigan Resins Corp.[18]

Vinyl chloride: Produced by the addition of HC1 to acetylene catalytically in aqueous solution (and competi-

Table IX—Estimated Acetylene Purification Costs, Solvent Extraction

(Annual Production Rate: 20 Million lbs. of Acetylene)

	Arc	*Oxygen Oxidation*	*Air Oxidation*	*Wulff*
1. Capital investment	$1,790,000	$1,930,000	$3,560,000	$1,880,000
a. Annual gross earnings required for 10% profit, 10% depreciation, and 47% Federal taxes	518,000	558,000	1,030,000	544,000
b. Capital cost as ¢/lb. of acetylene	2.59	2.79	5.15	2.72
2. Utilities				
a. Fuel gas @ 15 ¢/MM Btu	55,000	63,000	155,000	61,000
b. Cooling water @ 3 ¢/Mgal.	31,000	35,000	78,000	34,000
c. Steam @ 35 ¢/M lbs.	29,000	34,000	83,000	32,000
d. Electricity @ 0.7 ¢/kwh	12,000	13,000	17,000	12,000
	$ 127,000	$ 145,000	$ 333,000	$ 139,000
3. Labor and supervision				
a. Two men/shift @ $2.00/man-hr.	37,000	37,000	37,000	37,000
4. Works overhead @ 100% of labor and supervision	37,000	37,000	37,000	37,000
5. Maintenance and fixed charges @ 9% of capital investment	161,000	174,000	321,000	170,000
6. Carbon and chemical make-up	12,000	12,000	25,000	12,000
7. Operating cost	$ 374,000	$ 405,000	$ 753,000	$ 395,000
8. Operating cost as ¢/lb. of acetylene	1.87	2.02	3.76	1.96
9. Total purification cost as ¢/lb. of acetylene	4.46	4.81	8.91	4.68



tively by cracking ethylene dichloride). In 1949, production of polyvinyl chloride and polyvinylidene chloride was about 40 million lbs.; the total figure for polyvinyl chloride and copolymers (including acetate) was 226.8 million lbs. in 1949.

Producers are Du Pont, Dow Chemical, Carbide and Carbon, Monsanto, Goodrich, & Goodyear. Recently, U. S. Rubber purchased Glenn L. Martin's polyvinyl chloride plant at Painesville, Ohio. Goodrich and Carbide and Carbon have recently expanded production, and it is known that Firestone, Goodyear and General Tire are interested in participating more fully in the vinyl business.

Vinylidene chloride: Produced by chlorinating acetylene in acetylene tetrachloride or by alkali dehydrohalogenation of 1,1,2-trichloroethane. Producers of polyvinyl-vinylidene chloride are Goodrich, Firestone and Dow.

Neoprene: Made by adding HCl to vinylacetylene (dimerized acetylene) and polymerizing. Present producer is Du Pont at Louisville, Ky. with an annual capacity of 60,000 tons per year; a substantial increase in capacity (to an estimated 90,000 tons) has already been announced.

Acrylonitrile: The future of this chemical appears very promising. The only present production (American Cyanamid Co., at Warners, N. J.: about 27 million lbs./yr.) is through ethylene oxide plus HCN to ethylene cyanohydrin and dehydration to acrylonitrile.[17]

Indications are that acrylonitrile can be made more cheaply by the direct addition of HCN to acetylene in a liquid phase catalytic process. Monsanto at a new Texas location proposes the same operation with acetylene from natural gas. Apparently Monsanto will make its HCN from methane and ammonia, while Cyanamid will stay with calcium cyanide.

Fibers in commercial or semi-commercial production include Du Pont's Orlon (100% nitrile) Carbide's Dynel (40% nitrile), Chemstrand's Acrilan (about 85% nitrile). In addition, Cyanamid has developed an acrylic fiber; Allied Chem. & Dye is known to have experimented with a polyacrylamide fiber; and Tennessee Eastman is interested in acrylonitrile fibers.

In addition, various synthetic rubbers of the Buna N type have been developed for special uses, such as self-sealing fuel cells, oil-resistant items, and as a plasticizer for vinyl resins. In addition, there is considerable interest in the field of plastic-nitrile rubber compositions, which are expected to provide a large market for acrylonitrile.

The principal N rubbers are Goodyear's Chemigum, Goodrich's Hycar and Firestone's Butaprene; these rubbers contain from 30-45% nitrile. Standard Oil (N. J.) recently sold its Buna N plant at Baton Rouge to U.S. Rubber Co. There is no doubt that a lowered price for acrylonitrile (about 20 ¢/lb.) would result in greatly increased usage.

Acetaldehyde: Over 95% of acetaldehyde output is used directly for the manufacture of such chemicals as acetic acid and anhydride. It can be made by bubbling acetylene into an aqueous sulfuric acid solution, with dissolved mercurous sulfate as catalyst. (Competitive processes are by vapor phase oxidation or dehydrogenation of ethyl alcohol, from propane/butane oxidation, or a by-product from the Hydrocol operation at Brownsville, Tex.)

The only producer of acetaldehyde from acetylene in this country is Carbide & Carbon Chemicals Co.; in Canada, the large producer by this process is Shawinigan Chemicals, whose acetylene comes from cheap carbide. Acetaldehyde can be used to make a host of other chemicals, as crotonaldehyde, *n*-butyraldehyde, etc.

Acetic Acid: Acetic acid is obtained from acetaldehyde by an air oxidation of the latter with a manganous acetate catalyst. Such acetic acid (so-called synthetic acid) was produced in 1949 to the extent of 349 million lbs.; what percentage of the acetaldehide so used is derived from acetylene cannot be determined.

Acetic Anhydride: If acetaldehyde, dissolved in a diluent such as ethyl acetate, is oxidized, a mixture of acetic anhydride and acetic acid is formed. Acetic anhydride may also be made by adding ketene, often acetic acid-derived, to acetic acid.

Chlorinated Chemicals: Trichloroethylene is, on a volume basis, the most important solvent and degreasing agent in use today; it has displaced carbon tetrachloride for many applications. It is made simply by chlorinating acetylene to form acetylene tetrachloride, which is then dehydrohalogenated with a lime suspension.

Further syntheses are possible by chlorinating the trichloroethylene to pentachloroethane, and dehydrohalogenation to perchloroethylene. All of these compounds may be used as solvents. Further chlorination of perchloroethylene will give hexachloroethane, which was widely used during the war as an ingredient of smoke bombs.

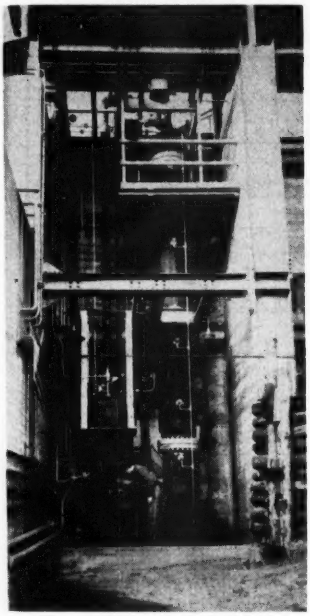
No precise production figures are available for trichloroethylene, but it is manufactured in very substantial quantities. Producers are Dow, Du Pont, Westvaco, Niagara Alkali and Hooker Electrochemical Co.

High-Pressure Reactions: So-called Reppe chemistry is being developed in this country by the General Aniline and Film Corp. Production is as yet only in the semi-works stage, but the compounds produced by vinylation, ethynylation and polymerization appear to have considerable promise.

Vinyl ethers, produced by the catalytic addition of acetylene to alcohols in the presence of a basic catalyst, are used in polymerizations and synthesis. Examples of monomers so produced are products made by vinylation of *p*-tert butylphenol (polymer known as Koresin) and of carbazole.

Ethynylation of formaldehyde with acetylene yields propargyl alcohol and butynediol; the latter can be hydrogenated to butanediol. Conversion of this to the lactone, ammoniation to pyrrolidone, vinylation, and polymerization of the resultant monomer are the steps to polyvinyl pyrrolidone.

Butanediol also has possibilities for use as a condensation agent with terephthalic acid to form a synthetic fiber. The synthesis of cycloöctatetraëne from acetylene in good yields also offers interesting possibilities.



REPPE-CHEMIE: Vinylation at General Aniline.

ECONOMICS

The question of economics of chemicals from acetylene must be finally resolved, not merely in terms of the price of acetylene, but also by the relation of the chemicals so produced to the consuming market. Therefore the following two basic situations must be compared economically:

a) Preparing chemicals from acetylene produced from cheap natural gas in the Gulf Coast area, and then shipping these chemicals to Eastern markets.
b) Buying marginal carbide at Niagara Falls, producing acetylene chemicals there, and shipping them down to Eastern markets.

Five basic chemicals are selected for comparison: acetaldehyde, acetic anhydride, vinyl chloride, vinyl acetate, and acrylonitrile (based on modification of the liquid phase German process, using direct addition of HCN to acetylene; HCN cost is based on a process for reacting methane with ammonia).

In each case, the relationship was derived between the cost of pure acetylene on the Gulf Coast, and the price of chemicals delivered to New York. These relationships are plotted on p. 25. To calculate the cost of the chemicals, only the price of acetylene was assumed to vary; acetic acid, HCl and HCN prices were pegged. This total price was based on a plant of economical size (50 million lbs./yr. of acetylene raw material), 10% depreciation, 10% profit on investment after taxes, plus freight rate to New York.

In each case, a point is indicated on the curve by an arrow for the equivalent cost of such a chemical, calculated on the same basis, and based upon a marginal price of \$45/ton for Niagara Falls carbide.

In the cases of acetaldehyde, acetic anhydride, vinyl acetate and acrylonitrile, it is seen that they may be competitively produced on the Gulf Coast and shipped East. These price relations are summarized on p. 25.

Actually, however, economic analysis must consider not only acetylene from carbide vs. natural gas, but also between acetylene and ethylene, which often can be used to produce the same chemicals. For example, the oxygenated derivatives can be based on acetaldehyde either from acetylene or from ethylene via ethyl alcohol. Vinyl chloride can be made either from acetylene or by cracking ethylene dichloride; acrylonitrile, from acetylene or through ethylene oxide.

As an example, economic study indicates that with ethylene at 4.25 ¢/lb., and assuming no credit for HCl produced from the cracking step, vinyl chloride can be made via ethylene dichloride at 11.9 ¢/lb. This contrasts with vinyl chloride at 10.9 ¢/lb. from acetylene based on natural gas.

Consideration of these economic studies supports the belief that acetylene is in for a big boost as starting material for a host of growing commodities; and the Gulf area, with its plentiful natural gas, looks like the likeliest spot for new production.

The authors are indebted to Mr. William Kapfer of N.Y.U.'s Chemical Engineering Department for his assistance in the economic analyses.

BIBLIOGRAPHY

1. Niebanck, J., *Chemical Engineering*, p. 131-133, June 1950.
2. Fuller, D. L., et al, "Manufacture and Purification of Acetylene", Fiat Final Report No. 921 (P. B. No. 81826), 1947.
3. Schoch, E. P., "Acetylene from Natural Gas", Publication No. 5011, June 1, 1950, University of Texas.
4. Carter, A. S. and Cain, G. A., "Production of Acetylene by the Partial Combustion of Methane", Fiat Report No. 988 (P. B. No. 67790), 1947.
5. Chemical Industries, Dec. 1950, p. 875.
6. Hasche, R. L., *Chem. & Met. Eng.* 49, 78-83, (1942).
7. Direrga, O. G. and Leeper, P. J., "Production of Acetylene from Methane in a Regenerative Type Furnace, Ruhrchemie Aktiengesellschaft, Oberhausen-Holten", Fiat Report 1079, (P. B. No. 80331), 1947.
8. Wulff, U. S. P. 1,834,965 (1932).
9. *Chem. & Eng. News*, p. 4244, Dec. 4, 1950.
10. Koller, *Khim Tverdoge Repliva* 8, 1149 (1937); *Chem. Abs.* 32, 4016 (1938).
11. D. R. Pat. 669,307 (1938) to Ruhrchemie, A. G.
12. U. S. P. 2, 383, 547 (1945) E. I. Du Pont de Nemours & Co.
13. U. S. P. 2,395,362 (1946) to Phillips Petroleum Co.
14. U. S. P. 2,146,448 E. I. Du Pont de Nemours & Co.
15. Kehde, H., et at, *Chem. Eng. Prog.* 44, 575 (1948).
16. U. S. Tariff Comm., Synthetic Organic Chemicals, U. S. Production and Sales, 1949 (Report No. 169).
17. Chemical Industries Week, p. 19, Jan. 27, 1951.
18. Chemical Industries, p. 905, June, 1949.

RESEARCH . . . .

High Voltage Fodder

Discovery that cathode rays predispose wood-cellulose to bacterial digestion, sparks speculation on sawdust as cattle fodder. Chemical extraction of cellulose for animal food, is an established European commercial procedure. But the new technique is simpler and would be cheaper in large-scale operation.

In this country too, considerable attention has been devoted to the utilization of wood cellulose—but not as cattle fodder. Major emphasis was always on the conversion of cellulose to sugar which then could be fermented to alcohol. Today there are two principal wood saccharification processes. Both depend on acid hydrolysis to separate cellulose from lignin and break the former down to component sugars. The Scholler process uses dilute sulfuric while the Bergius relies upon concentrated hydrochloric.

BELLAMY AND HUNGATE: From cellulose to fatty acids via cathode rays.

Electronic irradiation, a new concept in the field, is the center of considerable attention as a result of experimental work carried out by General Electric's Dr. W. Dexter Bellamy and Elliot Lawton in conjunction with researchers at the State College of Washington.

Sawdust and small wafers of basswood were irradiated for different periods of time in a modified million volt x-ray unit at General Electric's Schenectady (N. Y.) research laboratory. From GE, the wood specimens were shipped out to bacteriologist Dr. Robert E. Hungate, at the State College of Washington. His job was to determine digestibility of the irradiated samples.

Production of lower fatty acids (acetic, propionic, etc.) is a good measure of cellulose digestion. Hungate incubated the wood samples with bacteria found in the rumen* of cattle. After two days of digestion at 100 F, the samples were steam distilled to collect the volatile organic acids. Titration disclosed the amount of acid produced and the extent of digestion.

Results: Effect of the high-voltage electrons on ordinarily indigestible wood, varies with the amount of exposure. Digestibility is hardly increased by irradiation up to 6.5 million roentgen (r) units, then increases until a maximum is reach at 100 million r. At this stage, wood is digested by rumen contents almost as well as hay. When the 100 million r limit is exceeded, digestibility decreases and continues downward as the electron dosage is upped. Transformation of cellulose to indigestible compounds is offered as explanation of this inverse phenomenon.

Several theories have been proposed to satisfy the experimental evidence, but substantiation is lacking in all cases.

Easiest solution was based on the general belief that lignin in the form of a protective layer, prevents bacterial attack on the cellulose. Therefore, if the cellulose is digested, the lignin must be altered in some way which destroys its shielding capacity. But, chemical and microbiological analysis of irradiated lignin alone, show no gross changes—it remains resistant to bacterial hydrolysis.

As a result of additional tests, even the protective function of lignin is now open to question. If lignin does not protect cellulose from bacterial attack, the cellulose itself—contrary to experience—is resistant to bacterial fermentation. Answer here, is that irradiation changes it to a susceptible form.

Another proposed explanation states that irradiation destroys bacteriostatic agents, normally found in lignin. At present, all theories are equally valid; conclusive evidence is lacking in each case.

---

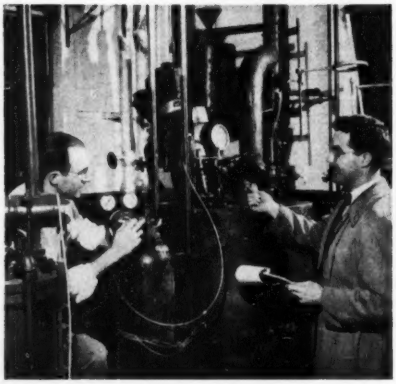
* First of a cow's four stomachs, seat of cellulose digestion.

1 COMPOUND X at this stage is only a gleam in Chemist Tessieri's eye. He makes a note of it.

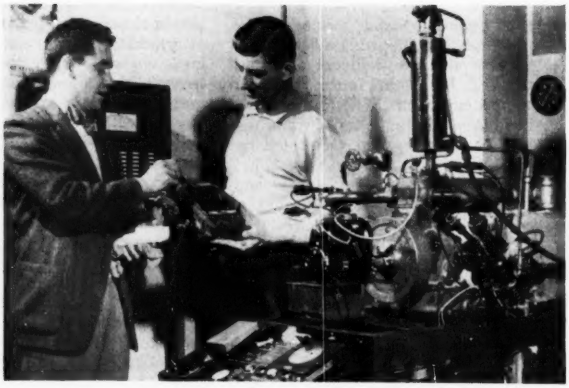
2 LIBRARY RESEARCH (with Literature Research Head Lou Stork's help) reveals what is known about the compound. Pickings are slim.

5 CORROSIVENESS is measured by weight loss of copper-lead bearing subjected to hot oil.

6 BENCH TESTS COMPLETED, Research Supervisor Rush McCleary (left) calls conference. Clearance permits next step: engine tests.

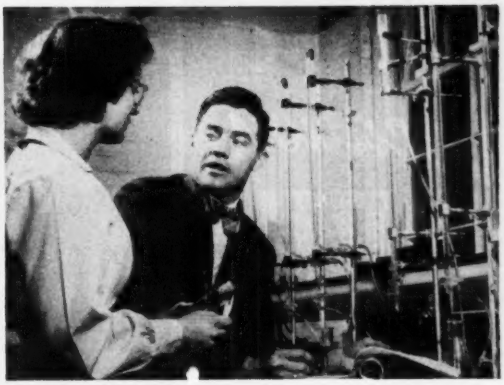


7 LARGE BATCH of Compound X is needed. Al Miller makes it as Tessieri gives directions.



8 ENGINE TEST (40 hours, Lauson 1-cylinder) exposes Compound X to actual operating conditions. Charlie Kyve points out absence of sludge.

3 **LABORATORY SYNTHESIS** marks first tangible step. Analysis proves it's the desired compound, so Tessieri starts tests.

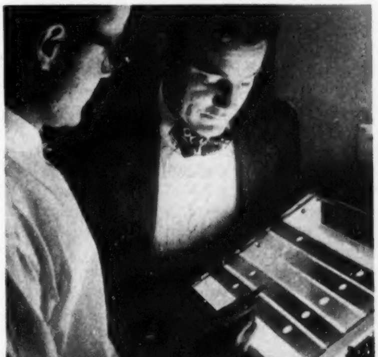


4 **NEUTRALIZATION NUMBER** is one of several determinations made by Mary Forman, Analytical Department.

Test Tube to Test Fleet

As unlike a sleek, whippet-fast 1951 model convertible as Jack Benny's ancient Maxwell, modern lubricating oils bear little resemblance to their relatively crude, untailored predecessors. Older lube oils were "straight," but about 15 years ago use of additives—to improve viscosity index, pour point, high-pressure characteristics, engine cleanliness, etc.—started to win serious attention. Today both the petroleum industry itself and the chemical industry are continually experimenting with new compounds, custom-designing oils for special needs.

Typical of this continuing research is the additives program at the Texas Co.'s Beacon (N. Y.) Laboratories. Here, in the Lubricants Research Department, chemists like John Tessieri originate, synthesize and test new compounds. This week the CIW Camera follows the progress of a potential additive from its conception to its performance under actual road conditions—a course that may well take over a year. Then the story is laid before the Technical and Research Division of the Refining Department which, after conferences with the laboratory representatives, decides whether Compound X is good enough to warrant commercialization. If it is, plans are made and set rolling for scheduling, manufacturing and marketing a new—and better—motor oil.



9 **X-RAY DIFFRACTION** pattern of combustion deposit is interpreted by Jim Fitzwilliam.

10 **TEST FLEET** is final, toughest hurdle. If Compound X comes through and receives management approval, Texas Co. contracts for its manufacture.

GREEN AND MOSES: Metal oxides provide the key.

Catalyst Helps Burn Waste

Metallic oxide catalysts are key to new process for vapor-phase combustion of organic wastes.

The new method is more convenient than biological treatment, cheaper under many conditions than incineration.

A new plant, budgeted by Du Pont for its Belle, W. Va., location, will embody a catalytic oxidation process unveiled last week.*

Depending on the use of metallic oxide catalysts, the process will simplify disposal of organic waste materials that were formerly a bothersome nuisance.

Via Literature: Development of the new process began in a very prosaic manner. A literature reference in a Du Pont Engineering Department report referred to the increase in oxidation rate of solutions of sodium sulfite in the presence of low concentrations of cobalt, suggested possible use of low-temperature catalytic oxidation to dispose of waste solutions of organic materials.

Work on the process was originated and directed by D. V. Moses also of Du Pont. At present, the technique can be used to treat only vaporized waste with air; but there are indications that the process can eventually be made to work on liquids, as the original hint suggested.

Good results have been attained with catalysts containing oxides of copper, chromium, manganese, nickel and cobalt. A copper chromite catalyst will be used in the new plant.

Two Streams: The new plant will dispose of two aqueous waste streams. One contains 3.5% organics—principally formaldehyde, with some methanol and formic acid; the other, 8% organics—primarily ethylene glycol derivatives.

The wastes are drawn from distillation columns as vapors and oxidized with air over a chromitic catalyst at a temperature of 250-275 C. No waste is left to dispose of, for the organics are almost completely converted to carbon dioxide and water.

The new process can also be applied to streams that exit in the liquid phase. In the new plant one stream is drawn from a vacuum distillation column and it has been found cheaper to condense this stream and revaporize the atmospheric pressure than to compress the vapor.

* By Du Pont's "Bud" (Ralph V.) Green, to the Manufacturing Chemist's Assn.'s Sixth Conference on Air and Water Pollution.

Alternates: Conventional methods of treating organic wastes are incineration and biological treatment, either by the activated sludge process or in a trickling filter.

Any biological treatment requires a large tract of level land, unavailable in mountainous West Virginia where Du Pont's Belle Works is located. Also, many organic wastes are toxic to bacterial growths.

Incineration is entirely feasible and, in certain cases, less expensive than catalytic oxidation. Initial investment for a catalytic oxidation plant is always higher than for an incinerator—usually about 20%-30% more. But under the most favorable conditions (2.5% organic material in the waste), operating cost of a catalytic oxidation plant is only about 15%-20% that of an incinerator. When the concentration of organic material in the waste reaches about 4.5%, costs of incineration and catalytic oxidation are about equal.

Pilling the Trick: A copper chromite catalyst formed by pilling with graphite, following by burning out the graphite, exhibits much greater activity than a fused catalyst.

Complete conversion has been maintained for 1,000 hours in pilot-plant tests, but care must be taken to prevent sintering of the catalyst surface (600 C.) when operating with a waste that contains relatively high concentrations of organic wastes. Each increase of 1% in the concentration of methanol, for example, raises the temperature of the exit gases about 75 C.

Limited tests indicate that sulfur compounds poison the catalyst when operated below 300 C. Low concentrations can be tolerated by copper chromite above this temperature.

Another Weapon: The new catalytic process provides another means of attack on the difficult problem of disposing of organic wastes. Development of the liquid-phase process, still under study, will greatly broaden the scope of its application.

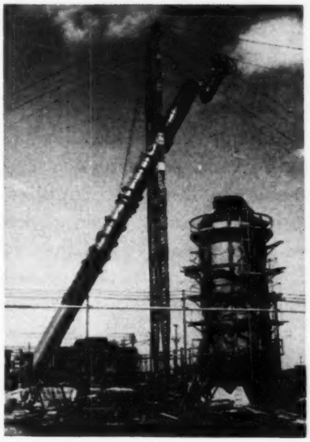
Metal-Glass Bond

Stronger than Glass: Metal can now be soldered to glass with a bond that is stronger than the glass itself. The new process, developed by General Electric Co., can also be used to solder metal to ceramics and carbon.

Titanium Hydride: Titanium hydride is used to coat the areas to be soldered before solder is applied to both the glass and metal. The parts are then joined and heated under a vacuum. At about 900 F. the titanium hydride decomposes, causing the then-molten solder to adhere to the painted areas. A strong bond forms upon cooling. Use of soft metal solder will provide a glass-to-metal seal which can be subjected to wide temperature changes without cracking the glass.

Now in use in aircraft ignition systems, investigations are expected to determine many other locations where the new process can be used advantageously.

Hypersorber Tower



The 207-foot Hypersorber tower at Dow's new ethylene plant at Midland, Mich., was raised by the Austin Construction Co. with the help of two 190-foot "stiff legs" rented from the Sun Oil Co. The 300-ton tower is believed to be the largest single drum ever erected in one piece.

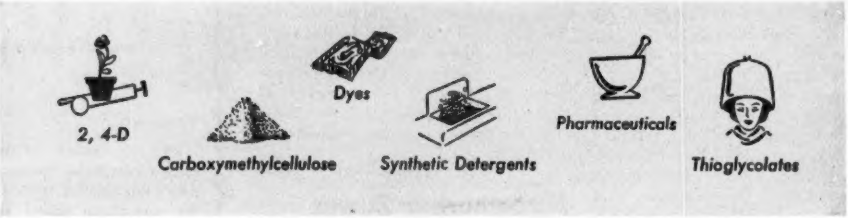
Kel-F Tubing: Plax Corp. is offering Kel-F, polytrifluorochloroethylene, as 2" diameter tubing; sheets up to ¼" thick; extruded rods 7/16" in diameter; and molded rods 1½" thick.

•

Eccentric Screens: A new tandem-mounted screen unit is being produced by Patterson Foundry & Machine Co. Two screens are assembled on a common support frame and driven by a single motor. The lack of vibration permits them to be installed without rigid supports. The single drive shaft powers the two eccentric drive heads so that the heads rotate in the same direction.

HOOKER MONOCHLOROACETIC ACID

To Make Today's Products Better



Versatile Monochloroacetic Acid is aptly called "today's intermediate" because so many currently important products can be made with it.

As a major producer of chlorine and chlorine products, Hooker has a fund of valuable experience in the production and handling of Monochloroacetic Acid and other chlorinated intermediates. Hooker's new Monochloroacetic Acid plant produces a product high in quality and dependably uniform.

Listed below are some of the characteristics of Hooker Monochloroacetic Acid. Technical Data Sheet 752-B gives more complete listing of physical and chemical properties. It will be sent when requested on your company letterhead.

Supplies of Hooker Monochloroacetic Acid are necessarily limited in view of current demands. For up-to-date delivery information, we suggest that you keep in touch with your Hooker sales representative.

MONOCHLOROACETIC ACID

Description: White crystalline material with a strong sweetish odor. Corrosive to the skin. Very soluble in water and benzene; soluble in most organic solvents.

Synonyms	Chloroacetic Acid, Chloroethanoic Acid	Boiling Point	189°C
Formula	$CH_2ClCOOH$	Solubility	
Molecular Weight	94.5	Water	Very soluble
Freezing Point	61.6°C	Benzene	Very soluble
		Other organic solvents	Generally soluble

Uses: Intermediate in manufacture of carboxymethylcellulose, 2,4-dichlorophenoxyacetic acid, cyanoacetate, indigoid and thioindigoid dyes, ammonium thioglycolate, thioglycolic acid, glycine and other chemicals of commercial importance. It has been suggested as a preservative alone or in connection with other compounds for hides, skins, etc.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

3 FORTY-SEVENTH ST., NIAGARA, FALLS, N. Y.
NEW YORK, N. Y. • WILMINGTON, CALIF. • TACOMA, WASH.

HOOKER CHEMICALS

10-1375

BENZOIC ACID • CHLOROTOLUENE • SODIUM BENZOATE • CAUSTIC SODA • MURIATIC ACID • PARADICHLOROBENZENE • CHLORINE

GLASS CLEANERS: Spraying again instead of wiping.

Back-to-Liquid Trend

"Squirt on" glass cleaners are back in the sun after several years in "wax-type's" shadow.

Some signs of the trend: Drackett has dropped Windex Wax, is pushing its name brand leader, Windex Spray; Boyle-Midway will soon be marketing Aeromist in a squeeze bottle; and lesser known brands of "glass waxes" are becoming casualities.

But Gold Seal, Glass Wax originator, will retain a dominant position, is breaking a new promotion for its product.

Whether liquid glass cleaners really were anything but A-1 in the consumer's heart is debatable. Drackett Products claims that its long-time leader in the field, Windex Spray, was never out of first place.

Back in late 1948, however, when Gold Seal was making specialties history with Glass Wax, Drackett, like everyone else, came out with a similar type. Called Windex Wax, it helped the company maintain its position in the face of Gold Seal's promotion blitz. Bon Ami, Boyle-Midway and just about every household specialty manufacturer joined the "wipe it on, wipe it off" parade, and the number of brands of the then-new glass cleaner mushroomed to at least several dozen.

Many companies already in the glass cleaner field went along with the crowd somewhat reluctantly, pointing out some of the shortcomings of the new type products and predicting that housewives would get over the craze. They haven't completely, but the market has apparently stabilized with liquids on top.

The 1950 Columbus Dispatch Consumer Analysis of the Greater Columbus Market shows the trend in that area: Windex had 32.6% of the market as contrasted to Gold Seal's 32.5% in 1950, whereas for the previous year the respective figures were 25.4% and 47.8%. Moreover, *The Milwaukee Journal's* tabulation of 14 national markets reveals that of 10 markets covered for glass cleaners in 1950, Windex was first in six, Gold Seal in three and Bon Ami in one.

Dusty Business: Those gaining by the turn of the tide point out that in wiping "wax-type" cleaner on, letting it dry and then wiping it off, a fair amount of physical labor is involved. Also on the debit side, the abrasive powder left on the glass surface is difficult to remove from rough or scratched surfaces, and it gets onto draperies, rugs, etc. Pressing the familiar plunger of a liquid dispenser, letting the formulation clean the surface and then wiping it dry seems more to the housewife's taste.

"Wax-types," of course, are essentially metal polishes with low solids, soft abrasives and rapidly-evaporating solvents (*CI, Dec. 1948, p.* 933), and most of them are suggested for multiple uses. A typical formulation contains 6-8% fine diatomaceous clay (abrasive) and fine bentonite clay (suspending agent); 15% solvent (Stoddard, isopropanol, or Cellosolves); 2% aqua ammonia; 1-2% emulsifying agent; and 75% water.

Liquid types depend upon the cleaning action of water-solvent mixtures, bolstered by a small amount of alkali, soap, ammonia or synthetic detergent. Synthetic detergents are especially valuable for they help to polish the glass, cut grease, and keep in suspension oils that may be added for odor. Lower aliphatic alcohols have been widely used as solvents, isopropanol being the most popular. It is a good cleaner, does not evaporate too quickly, is relatively nontoxic, and doesn't attack painted surfaces as used (20-50%). Other solvents in the formulator's kit include Cellosolves, Carbitols, methyl acetate, ethyl acetate, and ketones selected to give mixtures that don't dry too fast to clean, nor too slowly so that much rubbing is required. A little dye is also commonly added

Hurricane Warning: At the moment, liquid cleaner makers are having their day. Drackett obviously is convinced that Windex Spray is a match for the Gold Seal product and remaining imitators. Boyle-Midway has added a new note in packaging with its squeezable polyethylene bottle replacing the traditional plunger applicator, and will soon be selling kits containing this and a refill glass bottle. And the number of brands of "wax-types" has decreased until now only Gold Seal and Bon Ami (Glass Gloss) have brands with considerable national standing. (The latter company says its product is growing—although doesn't equal sales of its powder and cake--is convinced there is sufficient market for

it to stay in their pitching against Gold Seal.)

The relative serenity of the liquid boys may be short-lived, however. Gold Seal's dynamic president, Hal Schafer, has cooked up another drive for the housewife's 59¢. This time, instead of the "wipe it on, wipe it off" approach, he is beginning to bombard her with "Dry clean your windows." Memories of his promotion's effect on consumers when he first launched Glass Wax are still vivid. The consensus is that the liquid cleaner camp will need all its new gimmicks, for if Schafer doesn't win back as many consumers as he had, there is no doubt that he'll be able to hang onto his healthy share of the market.

Bombs Away

Can shortages may be keeping some manufacturers awake nights, but they haven't stopped the introduction of new products in the aerosol "bomb" field. Distribution isn't always possible on as great a scale as desired, but the sales-getting convenience of these gas-propelled specialties makes even a limited marketing effort an attractive proposition. Some of the latest:

Invisible Raincoat: Gard Waterproofing Spray, an 11-oz can being sold for $1.95 in the Chicago area by Gard Industries, Inc., contains synthetic resins in a petroleum vehicle. One can will treat two hats, two topcoats, and three or four pair of shoes. New markets are to be added, with national distribution by next year the goal.

Enamel: Fourteen colors of tractor and implement enamels will soon be available nationally under the Spraypak label of Chase Products, Maywood, Ill. Fine pigments are suspended in an alkyd varnish. The formulation is packaged in a 12-oz aerosol priced at $1.59. Chase is a large filler of other aerosols, is in good position can-wise to expand last year's test markets in rural Ohio and Michigan.

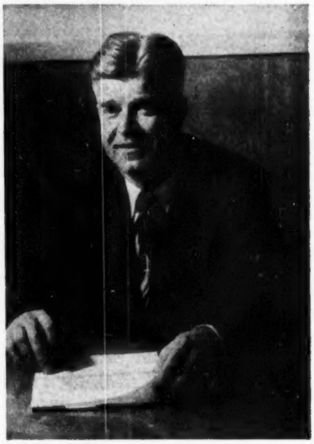
Plastic Fixatif: Sprayway Plastic Spray is Tru-Pine Co.'s (Chicago) name for its coating designed to protect illustrative material from smudging, but which can also be used to protect a variety of surfaces. The 12-oz container retails at $1.39.

Dry lubricant: A service station aid to quick lubrication of auto door lock assemblies, leaf springs, speedometer cables, etc. is the new aerosol dry graphite lubricant, "dgf-123." It's the product of AP Parts Corp., Toledo. O.

Mighty Miticide

Sulphenone, new Stauffer pesticide (active ingredients: p-chlorophenyl phenyl sulfone and related compounds), gets U.S.D.A. label approved for use on pears, apples, almonds. It will be commercially available only in the West this year, but a larger plant now in the planning stage will make possible national distribution by the 1952 season.

Stauffer Chemical this month cleared one of the toughest hurdles in reaching the commercial market with a pesticide when its Sulphenone was accepted for use on certain orchard crops by the U.S. Department of Agriculture and a number of western states. It is being sold as a 40% wettable powder (Sulphenone 40W) through agricultural dealers and distributors on the Pacific Coast for control of spider mites.



CHESTER ARNOLD: His team was death on mites.

A greater number of mite species succumb to Sulphenone than to other miticides, for it is one of the least specific of those now on the market. Other important features: It is relatively non-toxic to higher mammals; orchard and field crops treated with the material have exhibited no off-flavor whether washed or unwashed, cooked or raw.

Sulphenone is recommended for control of clover, European red, two-spotted, Pacific and Williamette mites on almonds, apples, and d'Anjou and Bartlett pears. Rates of application are 20-30 lb. per acre. It is compatible with most pesticides and can be used to good effect in combination with

a variety of insecticidal materials.

The Long Trail: Progress of the new miticide from its synthesis at Stauffer's Torrence, Cal., research laboratory some time ago to its present commercial stage is typical of many new agricultural chemicals. When the Torrence group came up with the product, about all that was known was its chemical composition, but other members of Stauffer research director Chester Arnold's team soon came into play.

The main Richmond, Cal., lab took a look at it, tagged it R-242 and sent it to the company's agricultural research lab for evaluation. Here a long series of tests pointed to its pesticidal value, and as Sulphenone, it went out for tests on crops. These involved cooperative tests with state and federal experiment stations, field studies by Stauffer personnel and semi-commercial tests.

Actually the latter applications resulted from demand by growers for quantities of the material that they had heard was proving so successful on the experimental level. During 1950, over 50,000 lb. of Sulphenone were sold on the Pacific Coast. Analysis of the results obtained has led to present commercial recommendations for the material.

Current production at Stauffer's Los Angeles plant is limited, so this year's commercial distribution will be confined to the West. The rest of the country will not be left out entirely, however, for it is scheduled for additional test applications. And plans for another—and larger—plant indicate that there will be enough Sulphenone for all by next season.

•

More on Warfarin: Post Office Regulations have been modified to permit shipping of the rodenticide, warfarin, in cartons containing 12 one-lb containers of the mixed bait. Previous mailing limit of 12 lb conflicted with manufacturers' practice of packaging 12 one-lb containers to a carton. The existing mailing limit of 8 oz for warfarin concentrate was not changed.

Also, to eliminate exaggerated claims for warfarin, the National Better Business Bureau has issued a bulletin to inform manufacturers, advertisers, etc. of descriptions of the rodenticide acceptable to the Fish and Wild Life Service, U.S.D.A. and itself. Copy of it can be had from NBBB, Chrysler Building, New York 17, N.Y.

Latest retail brand is Hy-Power Raticide, product of Wy-To Chemicals, Chicago. Price is $1.25 for 2½-oz container; selling area is Illinois, Wisconsin, Northern Indiana.

•

Cork Binders: Borden's Chemical Division has just introduced four new water- and fungusproof cork composition binding resins under its Cascophen trade mark. They are phenolic types with varying properties depending upon consumer requirements. The products are used in making shoe parts, gaskets and newer types of floor tiles.

•

Shoe Polish Plant: Whittemore Corp. will open a shoe polish plant at Fayette, Ala. in June or July. Manufacturing operations and offices will occupy four buildings. About 100 will be employed initially, but this number is expected to double within a year. The company, which has its headquarters in New York, was purchased by the National Southern Products Corp., Tuscaloosa, Ala., last December.

•

Easy Off: Marvel is the trade name of Wy-To Chemicals' (Chicago) new wallpaper remover just being distributed in the Illinois-Wisconsin-Northern Indiana market. Packaged in an oval glass bottle, it is being retailed at 49¢ (12 oz) and 98¢ (qt) through hardware and paint dealers. In use, three tablespoons are added to a gallon of water and applied with sponge, brush or sprayer. When the paper is soaked, it is easily scraped off.

•

Sky Lift for Aldrin: Calls from Iran for pesticides to curb a locust infestation threatening wheat and barley crops were answered with an air shipment of 13 tons of the new Julius Hyman insecticide, aldrin, by its distributors, Shell Chemical Corp. The material was made available at the U. S. State Department's request. Shell also sent its pest control expert, John Hardy, to direct aldrin's application.

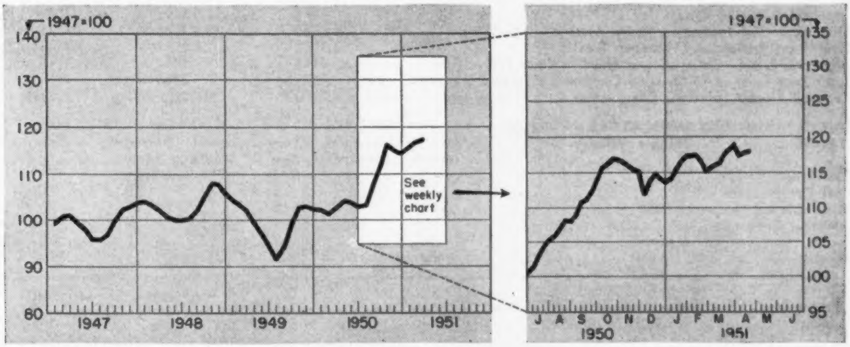
•

Barrier Creams: A new line of protective creams and liquids is now being distributed to industrial consumers by the safety division of Boyer-Campbell Co., Detroit. There are six different types of creams; four, of liquids. Creams are packed in 8-, 12-, and 16-oz jars; liquids in pints, gallons and 50-gal drums.

PICTURES IN THIS ISSUE

Cover (top)—Penn Salt; Cover (bottom)—Union Carbide & Carbon Corp.; p. 9—Freeport Sulfur Co.; p. 10—Elwood Payne; p. 12—Reni Photos; pp. 28, 29, cover (middle)—Lyn Crawford; p. 30—Hans Basken.

CHEMICAL MARKETS . . .



CHEMICAL INDUSTRIES OUTPUT INDEX — Basis: Total Man-Hours Worked in Selected Chemical Industries

Recent lifting of restrictions on West German chemical industry signalled a new program to boost production and to regain a large share of the substantial export market. The ammonia and nitrate producers plan to lift annual capacity from 500 thousand tons to over 6.5 million tons in a two-year drive.

After five years of controversy, the Allied High Commission has readied a definite plan to break up the I.G. Farben cartel. Approximately 80% of the holdings would be divided among nine separate concerns, compared with the 214 companies comprising the empire which once controlled 85% of German chemical production.

Relief for many chemical importers is on hand following a decision by the Office of Price Stabilization to grant pre-Korea markups, but locating something to sell with CIT approval is the next problem. This action will be a warmup for tackling the more difficult problem of chemical importers, squeezed between rising import costs and fixed domestic ceilings.

One conspicuous example of the importer's dilemma today is the situation in cresylic acid from England. An importer of this commodity whose ceiling is $1.45 a gallon would have to pay $1.50 a gallon for January, 1952 delivery, earliest available.

Critical resorcinol shortages will be relieved if Borden's Chemical Divison gets the go-ahead from NPA for a million pound-a-year plant in Tacoma. The plant output, entirely for plywood adhesives, will mark Borden's entry into a field which is currently divided by Koppers and Heyden.

Within a day following end-use allocations on vegetable tanning materials, prices of quebracho extract from Argentina rose more than 10%. This strategic import is used not only in tanning, but is urgently needed in oil well drilling, and in a variety of other uses.

MARKET LETTER

MARKET LETTER

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Chemical Industries Output Index (1947=100)	119.5	119.0	104.4
Bituminous Coal Production (Daily Average, 1000 Tons)	1,662.0	1,752.0	1,931.0
Steel Ingot Production (Thousand Tons)	2,065.0	2,057.0	1,912.0
Wholesale Prices—Chemicals and Allied Products (1926=100)	144.5	144.9	117.2
Stock Price Index of 14 Chemical Companies (Standard & Poor's)	235.5	224.9	181.3
Chemical Process Industries Construction Awards (Eng. News-Record)	$29,302,000	$9,852,000	$17,527,000

MONTHLY BUSINESS INDICATORS—FOREIGN TRADE (Million Dollars)	EXPORTS			IMPORTS		
	Latest Month	Preceding Month	Year Ago	Latest Month	Preceding Month	Year Ago
Chemicals	63.0	58.1	53.4	25.8	26.4	13.3
Coal Tar Products	5.0	5.4	3.9	4.4	2.9	1.0
Medicinals and Pharmaceuticals	18.7	16.2	12.6	1.0	1.5	0.3
Industrial Chemicals	9.3	8.6	6.9	11.1	11.9	1.6
Fertilizer and Fertilizer Materials	2.6	2.0	8.7	8.6	9.0	6.7
Vegetable Oils and Fats, Inedible	4.4	4.9	6.8	10.2	12.5	5.6

For the second week in succession, the wholesale price indicator showed a slight dip, primarily the result of lower prices on imported raw materials. In the meantime, the CIW chemical output index hit 119.5, high-water mark of the mobilization program to date.

Demand for hydrochloric acid for export is a surprise to producers. Formerly a stay-at-home chemical, increasing quantities are now heading to South America. Current shipments of 20 Baume acid are quoted by manufacturers as follows:

25-74 carboys	$3.20 per cwt.
250 carboys (carload)	$2.80 per cwt.

Forthcoming parley between the Naval Stores Industry and the Office of Price Stabilization on April 27 will seek a more satisfying pricing formula than the existing one. Producers now find themselves trapped between an immovable ceiling and rising gum prices.

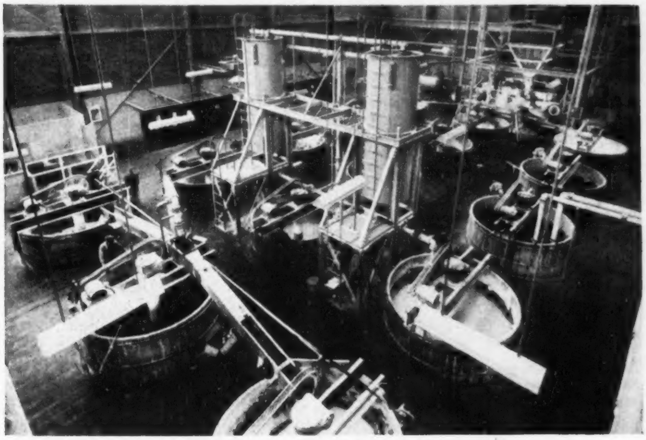
Implications of the huge Abaden refinery shutdown in Iran could well lead to higher petroleum prices. Unless an early solution can be found to this knotty international problem, U. S. supplies would suffer a setback while mobilization requirements are mounting daily.

Ethanolamines remain in the spotlight with the authorized expansion of production facilities by Dow Chemical Company. Immediately justified by the demand for sulphur recovery (see p. 9, this issue), the expansion will also improve Dow's capacity to meet other rapidly growing uses.

SELECTED CHEMICAL MARKET PRICE CHANGES—Week Ending April 26, 1951

UP	Change	New Price		Change	New Price
Egg Albumen, tech.	$ .10	$1.05	Quebracho, 63%, ord.	$ .0125	$ .1025
Mace Oil	.30	5.25	Ouricury Wax, ref.	.15	1.07
DOWN					
Carnauba Wax, No. 1 yellow	.02	1.28	Eucalyptus Oil	.10	1.30
Castor Beans, fob. Brazil/ton	15.00	285.00	Grease Oils, No. 1	.02	.235
Cedarwood Oil	.05	.70	Menthol	.45	11.25
Cocoa Butter	.03	.74	Quicksilver, 76 lb. flask	1.00	213.00
Coconut Oil, crude, tanks, Pac. ports	.005	.185	Shellac, No. 1	.01	.55
Copra, cif. Pacific/ton	15.00	235.00	Tin	.05	1.42

All prices per lb. unless quantity is stated



DAVISON'S SILICA GEL: Relief for aviation gasoline producers.

Silica Gel Spurs Silicates

Sodium silicate production moves ahead to keep up with new and expanded uses for silica gel.

Adhesives are an expanding outlet, but silicate requirements in the soap industry have slackened as synthetic detergents pre-empt over one-third of the market.

Further silicate expansion is limited by scarce soda ash; silica gel, by sulfuric acid shortage.

Although some dislocations will undoubtedly be felt in the mobilization program from time to time, output of high-test gasoline will be ample—thanks in large measure to silica gel catalysts. Production of these cracking catalysts, containing 90% silica and 10% alumina, has been gathering momentum rapidly in 1951.

As CIW previously reported (*Jan. 27, 1951*) three new plants will be in production by early 1952, bringing total capacity to around 110 thousand tons annually. All of this silica gel comes from sodium silicate, an important inorganic chemical which before ten years ago had rarely been as petroleum modification.

Traditionally, sodium silicate producers have found their best outlets in improving the detergency of soap, adhesives for paper board cartons, and various smaller uses. Adhesives applications have continued to expand steadily in tempo with the corresponding demand for all products of industry. While most of the other uses have gained ground because of special merit—or were carried along in the tide of industrial expansion—utilization in soap has declined in the last few years with the advent and continued growth of synthetic detergents, which today have captured over one-third of the former soap market.

Manufacture of silica gel from sodium silicate, negligible 10 years ago, has become the outstanding single uses with the best potential for further expansion; while unremitting gains of synthetic detergents has relegated sodium silicate use in soap to third place.

Enough Silicate: Refashioning of the silicate end-use design has been accompanied in the past decade by periodic shortages, almost unprecedented until then. In 1942 dwindling imports of oils reduced soap production and a silicate glut seemed inevitable. By 1943, however, demand for aviation gasoline cracking catalysts developed a shortage which was partly alleviated with new production by Diamond Alkali and Pittsburgh Plate Glass. In 1946, supply improvement of silicate did not materialize because of soda-ash shortages and obsolescence of war-fatigued equipment. During 1947 and 1948 came an increase in soap consumption, and expansion of demand for silica gel in cracking catalysts as well as in such non-recurring uses as mothballing of the fleet and merchant marine. In the period from 1949 until the middle of 1950, production showed only slight gains because upsurge of demand for synthetic detergents tended to offset other advances.

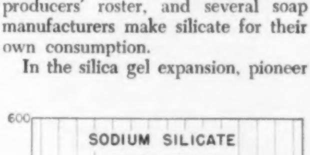
Since Korea, silicate production has been pointing consistently toward new records to meet the mobilization requirements for silica gel in catalysts for the petroleum industry and widely assorted uses for the military.

CIW estimates that production of sodium silicate in 1951 will reach 550 thousand tons and might well exceed this mark if soda ash supplies are ample and producing plants experience no important down-time.

Completion and operation of the new silica plants in 1952 raises the probability of periodic scarcity at that time. Before that situation develops, however, restriction of exports, which comprise about 3% of production, would add to the available potential.

Producers of Note: Although there are more than thirty silicate-producing plants in the United States today, there are actually three major factors in the picture: Philadelphia Quartz, Diamond Alkali, and Cowles Chemical Co. By far the largest producer is Philadelphia Quartz, which currently holds better than one-third of the silicate market. Diamond Alkali is in second position, with three important expansions in five years, including purchase of a plant in Emeryville, Calif. Five other large chemical companies are also represented on the producers' roster, and several soap manufacturers make silicate for their own consumption.

In the silica gel expansion, pioneer



and dominant influence in meeting current heavy demand is Davison Chemical Co., with plants in Baltimore and Cincinatti accounting for every nearly half of al silica gel production. Other companies are maneuvering to get on this bandwagon. Some lively competition may be expected, although Davison's position will probably not receive serious challenge.

Taking care of the customers backlog will be the chief concern of the producers for a long time to come.

Pattern for Use: By early 1952, utilization of sodium silicate won't differ significantly from the following:

Use	Per Cent
Silica Gel	**40**
Adhesives	**29**
Soap and Detergents	**24**
Miscellaneous	**7**
Total	**100**

Products and prices: Sodium silicate, prepared commercially by the fusion of soda ash and sand, is available with a variety of properties, depending on the ratios of reactants. Excess of ash produces crystalline products such as meta- and ortho-silicate; excess of silica makes glassy products including the aqueous solutions of "water glass" of 40 Baume and 60 Baume. Prices of the solutions has not varied much in the last twenty years, price per ton in tanks currently quoted are: 40 Be—$19, and 52 Be—$37, Anhydrous sodium metasilicate brings $92 in carloads and orthosilicate $120 in the same quantities, a 30-40% boost since the end of World War II. Water glass solutions are used primarily for additions to soap, adhesives, and most of the silica gel. More alkaline products are employed for specialized applications as detergents and metal cleaners.

Factors of Supply: 1945 should bring some relief in the sustained shortage of soda ash, especially if the sodium silicate is used to make silica gel which goes directly into high-priority uses. Some difficulty may develop in obtaining sulfuric acid supplies for making silica gel from silicate, because many other equally urgent needs remain to be satisfied. But with supplementary utilization of hydrochloric for this purpose, difficulties should be minimized. From the overall outlook, producers survey the new era for silicates with optimism.

GOVERNMENT NEEDS

Bid Closing Date	Bid Invitation No.	Quantity	Item
General Services Administration, 219 S. Clark St., Chicago 4:			
May 1	CH-29267	600 bags soda ash (100-lb.)	
General Services Administration, 250 Hudson St., New York 13:			
Apr. 30	NY-2F-28839	2,100 lbs.	calcium hypochlorite
Navy Purchasing Office, 111 E. 16 St., New York:			
May 7	8636	121,000 lbs.	desiccant
May 8	8723	30,000 lbs.	storage battery sealing compound
May 8	8721	40,000 lbs.	soda ash (powder)
May 14	8734	90,000 lbs.	steam cleaning compound
General Services Administration, Region 3, Washington 25, D.C.:			
Apr. 30	5M-99020	400 gals.	interior oil paint
Apr. 30	5M-99021	700 gals.	synthetic-enamel thinner
May 9	99469-R-3	20,160 cont.	caustic soda (concentrated lye)
May 9	99475-R-3	120,000 lbs.	laundry soap (powder)
May 10	99470-R-3	70,000 lbs.	trisodium phosphate

GOVERNMENT AWARDS*

Item	Supplier	Location
Navy Purchasing Office, New York, N. 6.:		
DDT (100%)	Penn. Salt Mfg. Co.	Philadelphia, Pa.
New York QM Procurement Agency, 111 E. 16 St., N.Y. 3:		
soap, ordinary issue and laundry	Armour & Co.	Chicago, Ill.
transparent cellulose tape	Minnesota Mining & Mfg. Co.	
Chicago QM Depot, Chicago 9:		
soap	Chicago Sanitary Products Co.	Chicago, Ill.
soap	Kamen Soap Products Co., Inc.	New York, N.Y.
water purification tablets	Abbott Laboratories	Chicago, Ill.
	Smith, Kline & French Labs.	Philadelphia, Pa.
	Mann Chemical Labs., Inc.	Boston, Mass.
	Rexall Drug Co.	St. Louis, Mo.
	Lambert Pharmacal Co.	St. Louis, Mo.
heat tablets	J. W. Speaker Corp.	Milwaukee Wis.
	Bostwick Labs., Inc.	Bridgeport, Conn.
Navy Aviation Supply Office, Philadelphia 11, Pa.:		
trichlorethylene	E. I. Dupont de Nemours & Co.	Wilmington, Del.
cuprous oxide pigment (type 1)	Metals Refining Co., Div. of The Glidden Co.	Hammond, Ind.
olive drab enamel	Seidlitz Paint & Varnish Co.	Kansas City, Mo.
raw tung oil	W. R. Grace & Co.	Hartford 15, Conn.
linseed oil	Dixie Paint & Varnish Co.	Brunswick, Ga.
steam-distilled turpentine (type II)	Newport Industries, Inc.	New York, N.Y.

* Security regulations prevent disclosure of quantity and dollar volume.

BOOKS.......

Liquid Extraction, by Robert E. Treybal. McGraw-Hill Book Co., Inc., New York, N. Y.; vii+422 pp., $7.50.

The objective of this text is to review and organize the known facts concerning liquid extraction, so as to draw from these facts, as far as possible, general principles which can be used as guides in evaluation.

By outlining the potentialities and limitations of this unit operation as well as covering the physical chemistry of liquid-liquid equilibria, equipment and operating characteristics, and its use in modern chemical processes, the authors hope to remove much of the confusion frequently involved in applying extraction to separation problems.

Adsorption and Chromatography, Vol. V, by Harold Gomes Cassidy. Interscience Publishers. New York, N. Y.; 360 pp., $7.

As the fifth volume in the series entitled "Technique of Organic Chemistry" edited by Arnold Weissberger, this book focuses attention on the topics of adsorption and chromatography, as essential processes in organic chemistry. By discussing the principles involved, the author explains the various methods by which adsorption may be utilized as a tool for the separation of mixtures.

Briefly Listed

U. S. Atomic Energy Commission Contracting and Purchasing Offices and Types of Commodities Purchased, revised booklet explains how to do business with the Atomic Energy Commission, designed to assist businessmen interested in selling products to the AEC and its contractors; especially intended for the small business concerns. Supplied by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C, at 15¢ a copy.

1951 Industrial Directory, the first for Nassau and Suffolk Counties, Long Island, contains complete details on manufacturers, banks, freight carriers, public utilities and service organizations for the industrial marketer. Available from The Long Island Association, Garden City Hotel, Garden City, Long Island, N.Y., for $5.

Antibiotics and Chemotherapy, a new medical journal reporting experimental and clinical studies in the field of antibiotics, hormones and chemotherapeutics; attention is focused particularly on new developments, current practices and the possibilities and limitations of various antibiotics such as the "wonder drugs." Published by the Washington Institute of Medicine, 1708 Massachusetts Ave., N.W., Wasington 6, D.C. Subscription per year: $10; single copies, $1.10.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • **OPPORTUNITIES** • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

$1.20 a line, minimum 3 lines.
To figure advance payment count 5 average words as a line.

EMPLOYMENT WANTED and Individual Selling Opportunity undisplayed rate is one-half of above rate, payable in advance.

PROPOSALS, $1.20 a line an insertion.

INFORMATION

BOX NUMBERS count as one additional line in undisplayed ads.

EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $8.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page C. I. W.

NEW ADVERTISEMENTS received by 10 A. M. May 2nd at the New York Office, 330 W. 42nd St., New York 18, N. Y., will appear in the May 12th issue subject to limitations of space available.

"Consolidated Calling!"

BUYS and SELLS USED MACHINERY

FOR THE

CHEMICAL & PROCESS INDUSTRIES

Including Paint, Food, Rubber, Plastics, Sugar, Drugs, Cosmetics and Allied Fields. From a single item to a complete plant.

CASH FOR YOUR IDLE EQUIPMENT.

CONSOLIDATED
PRODUCTS COMPANY, INC.
14-18 PARK ROW, NEW YORK 38, N. Y.
BARCLAY 7-0600

1—Fitz. Comminuting Machine, Model D, stainless steel.
2—Mikro Pulverizers, #2-SI, Bantam (stainless)
8—Rotary Pellet Presses: Stokes D-3, Stokes D-4, Kux Model 25.
1—100 gal. Stainless Steel Type 347 Tank, 18" x 9', 250# pressure.
10—Stainless Steel Tanks, Type 316, 50 gal. and 80 gal., 30# pressure.

PERRY EQUIPMENT CORP.
1521 W. Thompson St.
Phila. 21, Penna.

FMC GEAR UP FOR BIGGER PRODUCTION WITHOUT DELAY

GOOD USED EQUIPMENT

Ready for Immediate Shipment

It's Impossible to List in this space the 5000 Machines available from your FIRST SOURCE

Send for our Latest List

FIRST MACHINERY CORP.
152 HUDSON ST. WOrth 4-5900 NEW YORK 13 N. Y.

Johnson Wax Company.—

We have several permanent openings for chemists in our new laboratory at Racine, Wisconsin. Excellent working conditions and benefit programs. We will consider applicants under 36 years of age with any of the following backgrounds.

M. S. in Physical Chemistry with experience or training in colloids. Development work.

M. S. in Organic Chemistry or equivalent. Research work on fatty or waxy materials.

B. S. in Organic or Physical Chemistry. Experience not required. Openings in both Research and Development.

Chemical Engineer. Experience not required. For process development on a pilot plant scale or technical service work.

Address inquiries to Dr. R. N. DuPuis, Research and Development Div., S. C. Johnson & Son, Inc., Racine, Wisconsin, giving full details as to age, education, experience, draft status, and salary requirements. Replies will be kept confidential and handled promptly.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

CHIEF CHEMIST: Splendid opportunity with large Pittsburgh area steel plant. Must have previous experience in manufacturing of high speed steels and die steels. Write now giving references and experience to P 9536, Chemical Industries.

TECHNICAL EXECUTIVE

Chemical engineer, experienced in production, research consulting and personnel management. Desires managerial post in company training programs, supervisory or advisory capacity in production or development in a chemical industry. PW 9589 Chemical Industries Week, 330 W. 42nd St., New York 18, N. Y.

AVAILABLE . . .

CUSTOM REFINING FACILITIES
- Distillation
- Extraction
- Separations
- Fractionations

Drum Lots—Tank Cars

WANTED . . .
- All Types of Crude Mixtures
- By-Products
- Residues
- Wastes
- Contaminated Solvents

TRULAND
Chemical & Engineering Co. Inc.
Box 426, Union, N.J. UNionville 2-7260

BOUGHT — SOLD

Glycols — Cellosolves — Ethanolamines
Titaniums — Lithopone — Zinc Oxide
Bichromates — Dyes — Colors, etc.
Soda Ash — Caustic Soda

CHEMICAL SERVICE CORPORATION
96-02 Beaver St., New York 5, N. Y.

Professional Services

A GUIDE TO CHEMICAL, CHEMICAL ENGINEERING, MARKETING AND LABORATORY SERVICES

CHEMICAL CONSULTATION, RESEARCH, DEVELOPMENT

THE PANRAY CORP.
Research Division
340 CANAL ST., NEW YORK 13

- Product and Process Development
- Sponsored Industrial Research
- Custom Organic Syntheses
- Chlorination Processes
- Chemotherapeutics
- Microanalyses

Phone: WAlker 5-7990

EVANS
RESEARCH AND DEVELOPMENT CORP.
Chemical Research ▶ Processes ▶ Products
Development Problems
Complete Laboratory ▶ Pilot Plant ▶ Mechanical and Optical Sections
Ask for NEW Scope Sheet C listing over 100 of our activities.
250 East 43rd Street, New York 17, N. Y.

RESEARCH LABORATORIES
FOSTER D. SNELL INC
CHEMISTS-ENGINEERS
29 WEST 15th ST. NEW YORK 11, N.Y.
PHONE WATKINS 4-8800

READER SERVICE . . . . .

HOW TO USE COUPON

Mail the coupon at the bottom of page. Circle page numbers of items about which you want more details. Then write your name and address and mail it to us. Your request will be forwarded to companies concerned, the answer coming direct to you.

MAKES IT HANDY

Products and literature in this issue are listed on these pages. There are three indexes. (1) Editorial items on new products, new equipment, new literature; (2) products advertised. (3) The index of advertisers is on the following page.

THE NUMBERS

Advertisements:—There is a page number on the coupon for each advertisement. Before the number, may appear, L, R. T. B (left, right, top, bottom), locating the ad on the page; small letters following (a,b,c) indicate additional products in the advertisement.

Editorial Items: — Numerals are page numbers; the ABC's distinguish among items where more than one is on a page. There is a number on the coupon for each item referring to new products, equipment, and literature.

EDITORIAL ITEMS

For more data, circle number on coupon.

NEW EQUIPMENT

TECHNICAL LITERATURE

CHEMICALS

EQUIPMENT

GENERAL

PRODUCTS ADVERTISED

For more data, circle number on coupon

SEARCHLIGHT SECTION

(Classified Advertising)

READER SERVICE COUPON

Mail to Chemical Industries Week, 330 W. 42nd St., N. Y. 18, N. Y.

NAME ______________________________

POSITION ______________________________

COMPANY ______________________________

ADDRESS ______________________________

CITY & STATE ______________________________

Editorial Items

31A	31A	44B	44D	44F	44H	44J
31B	44A	44C	44E	44G	44I	44K

Advertisements

I	2a	4	15a	16	27c	31	B34	T40a	B44	46b
B1	2b	7	15b	27a	27d	32	35	T40b	45	46c
	3	8	15c	27b	30	T34	36	T41	46a	46d

Expires July 28, 1951

BOOKLETS . . . .

Chemicals

Dimer Acid

16-p. booklet outlining characteristics, specifications and shipping and handling details of dimer acid (dilinoleic acid) along with pertinent formulations and procedures involving this compound and its potential applications in surface coatings, soaps, greases, esters, polyamide resins, ester-amides, hot tin dipping and insecticides. Emery Industries, Inc.

Resins

18-p. technical booklet entitled, "Resins for Adhesives," reporting on their contribution to film cohesion, bond strength, surface tack and other properties; examples are cited from three broad adhesive fields—rubber, cellulosics, and water soluble—to point out the usefulness of resins to the adhesives formulator and to indicate potential applications in reference to specific adhesives. Hercules Powder Co.

Protective Agent

4-p. company bulletin describing G-4 dichlorophene as a mildewproofing agent, either alone or in conjunction with copper naphthenate for fabric, thread and webbing of diverse items and listing the government specifications in chart form under which G-4 may be used to meet mildew requirements. Sindar Corp.

Fuel Oil Conditioners

4-p. bulletin describing advantages of fuel oil conditioners for the prevention of the formulation of hard carbon, tank sludge, clogged fuel lines and fouled burner tips. Power Plant Products Co.

Equipment

Packings and Gaskets

98-p. folder giving detailed information on the entire range of packings and gaskets in their multiple applications including service recommendations, installation procedures, and engineering data; among products covered are packing rings, teflon products, gaskets, gasket tape, and asbestos, flexible metallic, rubber sheet, asbestos fabric and braids and twisted packings. Raybestos-Manhattan, Inc.

Power-Operated Valves

40-p. manual offering a compilation of technical data on the use of pneumatic, hydraulic and electric operators for lubricated plug valves; contains typical piping diagrams, arrangements for motor controls, closing speeds, wiring data, and an extensive group of photos of actual installations. Rockwell Mfg. Co.

Temperature Controller

Bulletin presenting the design, measuring circuit and control system features of self-contained indicating deflection type instrument for automatic control of temperatures on any type of heating equipment. Wheelco Instruments Co.

Materials Handling

44-p. catalog giving general description and application data on the firm's line of gas and electric trucks, motorized hand trucks, hand lift trucks, and hand and electric hoists. Philadelphia Div., The Yale & Towne Mfg. Co.

Gradiation Heater

14-p. booklet on gradiation heaters for petroleum heat processing explaining the heating principle which distributes radiant gas heat uniformly about the surface of tubular heaters. Selas Corp. of America.

General

Missouri Industrial Buildings

Bulletin compiling list of 100 industrial buildings of various sizes and construction for sale or lease throughout the State of Missouri, directed at companies contemplating expansion and thereby interested in additional available locations. James Idol, Missouri Div. of Resources and Development.

Company Security

13-p. booklet entitled, "Protecting Your Company's Security," pointing out the methods of determining whether or to what degree a company is vulnerable, policy adjustments, setting up a security program, precautionary measures, etc. Research Institute of America.

ADVERTISER'S INDEX

BUSINESS STAFF

SALES MANAGER . . . . By Sawyer
BUSINESS MANAGER . . . . . Albert E. Weis
Atlanta . . . . Ralph C. Maultsby, 1311 Rhodes-Haverty Bldg., Atlanta 3, Ga.
Chicago . . . . Alfred D. Becker, Jr., Frank C. Mahnke, Jr., 520 N. Michigan Ave., Chicago 11, Ill.
Cleveland . . . . . . Vaughan K. Dissette, 1510 Hanna Bldg., Cleveland 15, Ohio
Dallas . . . . Jos. H. Allen, First Natl. Bank Bldg., Dallas 1, Texas
Los Angeles . . . . . . Carl W. Dysinger, H. L. Keeler, 1111 Wilshire Blvd., Los Angeles 17, Cal.
New York . . . . Knox Armstrong, Robert S. Muller, Charles L. Todaro, 330 West 42 St., New York 18, N. Y.
Philadelphia . . . . . . William B. Hannum, Jr., Architects Bldg., 17th & Sansom Sts., Philadelphia 3, Pa.
San Francisco . . . . . . Ralph E. Dorland, John W. Otterson, 68 Post St., San Francisco 4, Calif.
Boston. . . . 1427 Statler Bldg., Boston 16
Detroit . . 2980 Penobscot Bldg., Detroit 26
Pittsburgh . . 738 Oliver Bldg., Pittsburgh 22
St. Louis . . 3615 Olive St., Continental Bldg., St. Louis 8

IN YOUR PRODUCT DEVELOPMENT—

You Need a Good Man on the *Other End*, Too!

Product development programs are no longer "one-company" jobs. The bigger your program is, the more you have to rely on the other fellow—and the output of *his* research—to make your own succeed.

Through its continuing development work on both basic and new industrial chemicals, General Chemical can help you "man the saw" in many ways:

For example, General's research has introduced a number of important new industrial chemicals. Some have proved the basis for customers' development programs or the answer to their development problems. Among these helpful "tools" are:

BORON TRIFLUORIDE AND COMPLEXES, *versatile fluorine catalysts for organic reactions;* SULFUR HEXAFLUORIDE, *remarkable new gaseous dielectric;* GENETRONS*, *aliphatic fluorine compounds; and* SULFAN*, *stabilized sulfuric anhydride for sulfonations.*

For special process requirements, you may find General's ability to produce commercial quantities of "custom-made" chemicals equally valuable to you.

These are but some of the services our product development program offers. A personal discussion of your problems may suggest other ways it can "team up" with yours. Let's review them.

* Reg. U. S. Pat. Off.

BASIC CHEMICALS

FOR AMERICAN INDUSTRY

GENERAL CHEMICAL DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

OFFICES IN MAJOR INDUSTRIAL CENTERS FROM COAST TO COAST